S·A·E Journal

JANUARY 1944

The Future of Aviation —Ralph S. Damon

The Effect of Wartime Fuel Developments Upon Post-War Automobiles—A. T. Colwell

War Tires—Availability and Performance —P. W. Drew

A Method of Predicting Life of Tractor Bearings —John Borland

Operating Temperatures and Stresses of Aluminum Aircraft-Engine Parts —E. J. Willis and R. G. Anderson

Cooling-System Maintenance

SOCIETY OF AUTOMOTIVE ENGINEERS

Research arises from a knowledge of the lack of knowledge.

Blueprint of tomorrow

He shatters precedent right and left! By doing so, the automotive engineer helps meet the needs of war. And in his deeds there lies a blueprint of what tomorrow holds.

★ ★ ★

Surely the wonders he performs today will find ready acceptance and approval in the postwar world. But not until the "unconditional surrender" of our enemies may the full story of his genius be revealed.

Meanwhile he does his wartime task without complaint...without applause from the public whom he serves so well. Meanwhile, too, Perfect Circle continues to work in close association with him as he devotes his skill to the future of his country.

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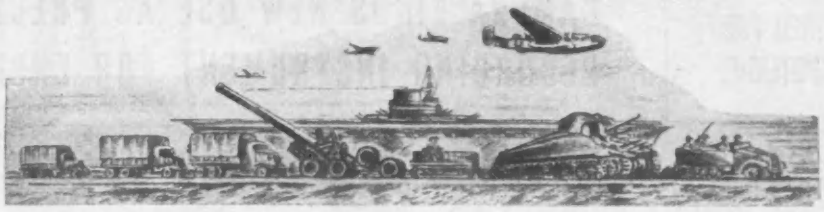


News of the **FEBRUARY** *Issue*

By Norman G. Shidle

No Substitutes!

PUBLIC attitudes toward science have always been a curious combination of gullibility and skepticism. One minute, industrial research results are damned as inadequate to the sudden needs of total war; the next, they are heralded as the basis of military miracles. One year, automobile designers are sneered at as lacking sufficient vision ever to make important design changes; the next, they are said to be hatching Models from Mars.

Since the truth about technical matters usually lies somewhere between two extremes, engineers and research men seem destined to stand permanently on an uncomfortably hot spot. Formation of asbestos inner soles as a natural result of conditioning by environment has long since reduced the degree of discomfort measurably, but a commendable tendency is growing to take time out for keeping the public in more regular touch with the facts of technical life.

Most important in this trend is the increasing willingness of automotive engineers to do this job themselves – individually or cooperatively. Relying on flying visits to our technical Land of Oz by outside writers has resulted but infrequently in entirely accurate interpretations – from insiders' viewpoints. Even other departments of our own industry have sometimes told the public technical stories which were somewhat less than precise.

Automotive engineers don't like to be misunderstood any more than any other group of human beings. They can best get outside understanding through encouraging and assisting competent members of their own group to be regularly articulate. Where the subject is technical, an engineer who can write and speak effectively will always carry the flag many miles farther than any non-technical word-wizard.

Magnesium Understudies Aluminum for Star Role In Aircraft Production

PROLONGED search for a metal having strength without weight and other qualities demanded by modern machine practice has been rewarded by the development of magnesium. The testing ground of war is proving it satisfactory for many purposes, a suitably useful metal supplementary to aluminum in aircraft and aircraft engine construction.

Abundance of magnesium ingot and expansion of fabricating facilities are estimated as being capable, by early 1944, of multiplying the volume of available magnesium sheet and of castings, forgings, and extrusions to an extent limited chiefly by currently incomplete knowledge of requirements.

February *SAE Journal* will present a report by J. C. Mathes, of Dow Chemical Co., Midland, Mich., on experience to date in using magnesium as a weight-saving metal in aircraft construction.

Die and sand castings, forgings and extrusions, of magnesium alloy will be described as 100% satisfactory. Thin magnesium sheets will be characterized as inferior to aluminum on a strength and service basis, but as lending themselves admirably to riveting, spot welding, and arc welding, and as satisfactorily replacing aluminum where low stresses permit, such as in oil tanks, wheel fairing, instrument panels, turret parts, and cases.

METALLURGICAL DETECTIVE WORK UNCOVERS CAUSES OF EXHAUST SYSTEM FAILURES

"INTELLIGENT ignorance derived from a study of failures," plus an undisclosed amount of intelligent metallurgical research based upon successes, have revealed how to avoid some of the difficulties experienced with some aircraft exhaust systems within the past few years.

The story, to be told in February *SAE Journal* by H. A. Campbell, of Solar Aircraft Co., San Diego, Calif., has aspects of an industrial detective thriller, but with the factual supplanting the romantic.

The average person could assume that the causes of failure might be too numerous to isolate, what with internal temperatures of 1000 F to 1700 F, exhaust gases traveling at high velocity, vibration extreme, and rain and sea atmospheres working their will outside. Associated factors disclosed in the pinning-down process will be shown to include fabrication by manufacturers newly converted to war production and by welders newly introduced to stainless steel.

Lacking test and service data, Mr. Campbell will draw tentative conclusions from research, such as:

- Titanium-stabilized 18-8 stainless steel meets all requirements for most installations; ordinarily is preferable to, cheaper than, columbium-stabilized.
- Intergranular corrosion from carbide precipitation is no substantial cause of exhaust system failure; occurs under metallurgical conditions infrequently encountered.
- Cracking of welds in thin stainless steel sheets is influenced by boron-containing compounds in welding flux, constitution of which demands rigid control.
- Zinc alloys exert seriously adverse metallurgical effects upon stainless steel, acting within minutes; contacts with zinc must be eliminated.

February Issue of SAE Journal
Will Present
Complete, Dynamic, and Illustrated
Report of
1944 SAE War Engineering-Annual Meeting

PLASTICS DESTINED FOR ENGINEERING SPOTLIGHT

PLASTICS are being readied for a post-war spotlight role in industrial manufacturing. The job of preparation appears to be one largely of documentation, for plastics admittedly are "different." Plastics engineers say they are convinced that once their peculiarities generally are known, plastics will become a No. 1 choice in many industrial fields, including the automotive.

W. F. Bartoe and Dr. D. S. Frederick, of Rohm & Haas Co., Philadelphia, Pa., will describe in February *SAE Journal* some of the currently established characteristics which should interest design engineers:

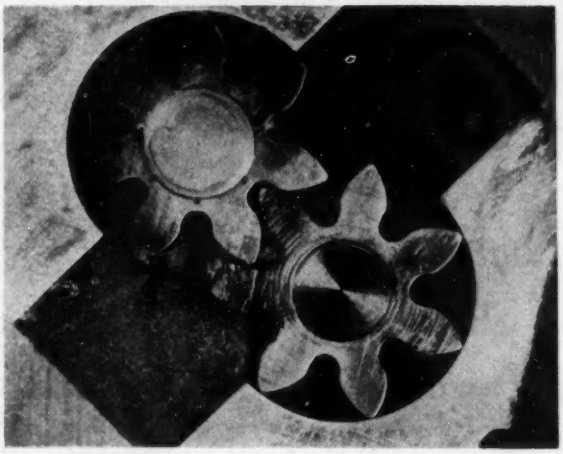
- Low weight per unit volume.
- Ease of fabrication.
- Low thermal conductivity.
- Transparency.
- Low unit cost for mass-production items.

The authors will propose that design engineers become familiar particularly with the ways in which plastics differ from other industrial materials in order to take advantage of these differences. For instance, they will explain that plastics, unlike metals which fatigue easily, resist sudden and temporary stresses accompanying vibrations or forced flexing, but yield to smaller stresses applied for longer periods.

Temperatures Critical

They will say that in the case of plastics, service temperature ranges are extremely critical and that atmospheric variations must have serious consideration. Both affect the strength of plastics. Also, unlike some other materials, service life of plastics may be influenced by stresses which, trapped during molding or forming, find relief by changing the shape or dimensions of the part.

Tabular data by which design engineers are accustomed to guide themselves in utilizing metals are inadequate for plastics, the authors will say, for many different factors are involved. Stress-strain data indicating "tensile strength" and "elastic limit" are described as inappropriate for plastics, which must be considered in terms of "dead-load," "cold-flow," or "creep."



Left: Multiple-flash photograph "freezes" motion of oil pump gears, traces air bubbles

CAMERA FINDS NEW USE AS PRECISION RECORDING INSTRUMENT FOR ENGINEER

FLASH and motion picture photography are filming the behaviorism of rapidly-moving, concealed working parts of aircraft engines.

Finding new uses as precision recording instruments supplementing strain gage and stroboscopic studies, still and high-speed motion picture cameras afford additional advantages such as making permanent, non-technical records on film. The pictures, magnified, studied at leisure, facilitate analysis and evaluation even of transient conditions, permit even the technically untrained to see exactly what happens.

Engineers long have endeavored to visualize what really goes on in an engine at high speeds. Also, they have wanted to measure motion. More than curiosity has been at stake; given these facts they could design parts to function satisfactorily under working conditions.

Above: High-speed motion picture camera makes permanent record of engine part in operation

They have sought to obtain the data through strain gage applications, but these are limited, interfere with operations, produce results difficult and controversial of interpretation. Stroboscopic studies serve the end of visibility, but application here too is difficult, observation temporary, and so concentrated that related factors are overlooked.

Still and motion picture cameras can withstand punishment and can function at angles and in places inaccessible to humans. Their permanent records yield accurate measurements, curves for plotting, and, magnified 150 times, trace motion and vibration faults from initial cause to ultimate effect.

New Engineering Tools

Use of these versatile new tools by engineers, particularly in analyzing oil flow, valve mechanism performance, cylinder head fin vibration, and effects of entrained air on oil pump functioning, will be described in February *SAE Journal*. H. D. Jackes, of Wright Aeronautical Corp., Paterson, N. J., will reveal that camera film records indicate that the functioning of many moving parts in an engine is far different than has been supposed.

Cases will be cited to prove how the camera's probity upsets theory. Breakage of cylinder head cooling fins, ascribed to vibration caused by air flow, was proved by motion picture studies to be a transient condition excited by cylinder head deformation during combustion. The camera identified even the few small areas of maximum vibration.

Analyzing valve gear functioning at high speeds defied strain gage technique. The camera made a permanent record at various engine speeds, penetrated the oil fog hiding working parts, revealed causes of difficulties to be quite different than expected.

Propose Post-War Civilian Flying Rules, Emphasizing Safety, Be Formulated Now

POST-WAR ownership and operation of aircraft has reached that realistic stage where Government regulation is preparing to step in, on the theory that some form of protection must be provided for civilian fliers and public alike.

Manufacture and operation of civilian planes are out for the duration but the post-war period will find the number of Americans acclimated to air travel enormously increased. The present affords a hiatus in which necessary Government regulations dispassionately can be discussed, leisurely planned, before some emergency demands drastic, unconsidered action.

Use of the wartime interruption in civilian flying to develop rational, reasonable, and practical safety regulations will be advocated in February *SAE* Journal by Edward Warner, of Washington, D. C., vice-chairman of Civil Aeronautics Board, past-president of SAE.

Mr. Warner will propose regulation not merely for the sake of regulating, but to do a safety job.

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The Society is not responsible for statements or opinions advanced in papers or discussions at its meetings or in articles in the JOURNAL.

JOURNAL INDEX AVAILABLE—A complete Index covering the twelve 1943 issues (Vol. 51) of the *SAE Journal* is now available to members and subscribers free upon request.

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Building for a Better World Tomorrow

. . . and smoother power transmission in civilian vehicles

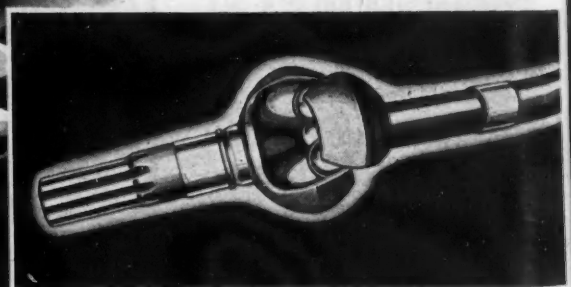
Among the peacetime products made by Bendix that are now a part of its wartime assignment is the Bendix-Weiss* constant-velocity Universal Joint.

This device is today taking its part in the great Allied offensives on world battle fronts. On many types of military vehicles, including trucks, half-tracks and amphibians, the Bendix-Weiss Universal Joint, by eliminating fluctuations in driving shaft velocities, is setting new standards of efficiency for smooth power transmission.

In the new day that is coming, this Bendix* product will be back from the war to serve civilian transportation needs in numerous new applications which call for smooth, vibrationless transmission of high torque at large angles.

Meantime, Bendix is not forgetting that part of its fighting assignment is to help service men keep war-essential civilian trucks, buses and passenger cars on the job.

* *Trademark of Bendix Aviation Corporation*



The Bendix-Weiss* Universal Joint utilizing the rolling-ball principle eliminates variations in angular velocity and insures smooth action at high operating angles. Because of the lengthwise rolling of the balls in the races, the need of a sliding spline is avoided.

THE INVISIBLE CREW
Precision Equipment by
Bendix
AVIATION CORPORATION

BENDIX PRODUCTS DIVISION
of Bendix Aviation Corporation
South Bend, Indiana

STROMBERG* CARBURETORS • BENDIX B-K* VACUUM POWER BRAKES
BENDIX* BRAKES • BENDIX-WEISS* UNIVERSAL JOINTS • BENDIX* CLEANERS

The FUTURE of Aviation

IF we do confound the experts and break through the speed of sound for regular aircraft operation, Mr. Damon predicts, it will probably be with the supercharged, flying-wing squirt-type plane.

Many other very specific technical prophecies are made in this article by one of the industry's leading engineer-executives. His views on the future of helicopters, private flying, transport aircraft and many other items are detailed frankly.

"Today's 'cocktail fuels'," he says, "will be tomorrow's beer."

by RALPH S. DAMON
American Airlines, Inc.

★ ★ ★ ★

EVERY now and then somebody sticks his neck out and says something about the future of aviation, and generally regrets it. This time it seems to be my turn.

I hope that I may neither fall into the class of those who so freely predict that something cannot be done nor into the class of those who predict everything in the hope that something of what they say will come true. In 1903 when the Wright brothers were actually beginning to fly, no less a personage than Simon Newcomb stated, after considerable study, that mechanical flight was an impossibility. In my own ground school and pre-flight training in 1918, I listened to a mathematical proof by a then outstanding aeronautical engineer showing that an airplane could not fly if one-third its gross weight exceeded a certain figure, even though at that time certain Handley Page and Caproni types of planes were already flying with weights in excess of the professor's mathematically impossible figure. More lately, some of our most respected experts are stating that no airplane can exceed the speed of sound, even though today it appears that, in dives, some airplanes have already approached and exceeded this speed and have recorded phenomena so peculiar that our normal thinking on aerodynamics must be completely revised at the speed attained, whatever that speed may be.

Of course, predictions of things to come in aviation are rampant. To date, their range has been unlimited and they concern airplanes with speeds of 1000 mph, planes in quantities that would blacken the sky, planes manufactured of pastel-tinted plastic, doing at least 50 or 60 mpg of gas, planes at such a price that no citizen would have any standing in the community unless he owned one. It would not become me to compete against such a varied and assorted array of predictions, since most of the superlatives have already been used up and those predictions have garnered the headlines for which they were intended.

Let us, therefore, try to be more moderate, avoiding both extremes, and try to see not all the possibilities or the impossibilities – but the probabilities within the next decade.

I propose to discuss the 10-year future, about 1953, with limits of plus or minus perhaps two years, based upon the probable time it takes to win the victory in this war, the probable type of peace which emerges, the probable social, economic, and technical organizations which arise from the peace, with a full humility with regard to the normal uncertainties of forecasting progress. Specifically, we shall assume that major hostilities of this war will have ceased in 1945. The victory will then have been won due to the overwhelming preponderance of the aviation effort on the part of the United Nations, who are today outstripping the Axis in production fully three to one. Not in production alone have we surpassed the Axis, but in quality of equipment as well, and our personnel are definitely superior, as evidenced by the official box scores in all war theaters.

Ralph S. Damon

This already existing pro-

duction preponderance is now being rapidly translated to the fighting fronts, and as our United Nations aircraft and airmen production continues to increase, particularly in this country, and as that of the Axis continues to decline due to the attrition of facilities by bombing, diminishing materials, and exhaustion of manpower, our United Nations preponderance by the end of this year should be easily five to one and perhaps ten to one, thereby foretelling the complete doom of the Axis aggressors.

At the time of the last armistice, there was a disarmament conference resulting in the naval holiday and certain other armament limitations. At that time aviation was not placed under limitation, except in certain nations of Europe, because it was never believed, despite the predictions of Gen. William Mitchell and others, that aviation could be the deciding influence in a war. Therefore battleships were restricted and aviation was not. After this war is won, I imagine exactly the reverse will be true. The first big problem will be to see that commercial aviation with a reasonable international freedom of the air to all nonaggressor nations is established. One of the recent proposals of Welsh Pogue, chairman of the Civil Aeronautics Board and a member of the United States Committee on International Air Policy, is worthy of thought and support: that for international traffic the planes of any nation shall have non-exclusive rights to pick up and discharge, to fly, to fuel, and to service in international traffic within any other nation. Such a plan does not infringe the intranational rights of any nation to its own cabotage, which should be reserved to each nation or granted to others by the nation involved.

Undoubtedly, such international freedom of the air can be given only as a result of mutual trust. For some time it may have to be given only to nonaggressor nations and then only perhaps in conjunction with some global organization of nations with an international police force ready to knock down aggressors as they arise. Or it might be required nonexclusively of all nations by each of the United Nations as a part of the peace, and later extended to every country under some protective international arrangement.

The important thing for us to know, and to want to do something about, is to be certain in the peace and the disarmament that there are no hamstringing regulations applied which may prevent the full, free, and happy use to the world of the benefits of commercial aviation. It is to be hoped that this may be the case, and for the rest of our engineering and practical discussion I shall assume this to be so.

■ Engineering Opportunity Great

At no time has the engineer in aviation stood on greater thresholds of opportunity. At the end of the last World War, the fastest pursuit plane had a top speed of 180 mph. Twenty years later, our commercial airliners were *cruising* at that speed, and one newer model not yet in production exceeds it by nearly 50%. Before this war ends we should have pursuit airplanes in production and in combat with speeds exceeding 450 mph. If we merely extrapolate the future in accordance with the past we should have transports cruising at better than 400 mph within 20 years and coming close to it by the period surrounding 1953.

It is true that certain concessions to altitude operation will probably be required to achieve these speeds, and that it will take long-range hops to obtain this altitude and therefore to achieve this speed; and that there will be an arbitrary loss of time at both ends of a transport run, which will be increasingly important in percentage as the absolute time required to fly between the arbitrary end losses is diminished. We are just on the threshold of having airplanes which approach so close to, or perhaps go through, the speed of sound that we are now definitely experiencing the difficulties so long predicted when we should achieve this speed.

Private airplanes of the executive type will approximate the performance of airliners. However, I feel that the more frequent schedules on transport routes and the expansion of routes themselves both in the United States and over the world to all the various cities and communities, irrespective of size, will tend to make such airplanes more and more confined to service off such airline routes.

■ Private Planes Will Improve

Strictly private planes for the man in the street will undoubtedly increase tremendously in numbers and their performance will be substantially better as our engineering and manufacturing technique progresses. Their performance will also improve over present standards, but will probably fall far short of the speeds and distances which can be attained by the airliners and executive-type planes.

At the beginning of the war we had in the United States approximately 30,000,000 licensed automobiles; 300,000 licensed motorboats, and 30,000 licensed planes, including air transports and the military. The number of private planes will benefit heavily from the large increase in airports, from the large increase in manufacturing facilities available, and from the large increase in customer demand, educated by the tremendous numbers of people connected during the war both with the military services and the factories and schools. At the end of this war, our Air Forces will contain approximately 10 times as many fliers and mechanics as it did at the end of the last war, and our factory personnel directly engaged in the manufacture of airplanes will bear approximately the same ratio. This gives us some indication of the tremendous increase in people who have been educated in familiarity with airplanes and who will have the urge to buy and to fly private planes. There can be no question but that the major portion will retain an exceedingly active interest in aviation.

Airplanes are limited to airports, big and small, just as boats are limited to bodies of water and automobiles are limited to roads. Therefore, I think we can expect that within the next decade private flying and privately owned airplanes will be appreciably increased. The increase may easily reach the order of magnitude of the licensed motorboats prior to the war, or 300,000 privately owned airplanes.

Strictly engineering-wise, there are so many developments – some of them so secret they may not even be mentioned – that our 1941 pre-war planes will be to those of 1953 as the 1916 Model T Ford was to the 1928 Model A. These improvements start with the fundamentals of aerodynamics including the suppression of all external protuberances including rivet heads, air intakes, and exhaust outlets. The smooth "flying wing," suppressing even the fuselage and tail itself, is an example and will probably reach its highest fruition in the largest type of planes where headroom for convenience and a maximum of absolute

[This paper was presented at a meeting of the Metropolitan Section of the SAE, New York City, May 20, 1943.]

dimension within balancing limits of the center of gravity will be possible. Ultimately, the present engine and propeller itself may be suppressed and replaced by the rocket or squirt type of propulsion, saving a tremendous part of today's structural weight. This type, I feel, will reach its highest potential in the high-speed supercharged high-altitude plane, whose cruising speed, to be economical, will have to be in what are today's top-pursuit-speed brackets.

If we do confound today's experts and break through the speed of sound for regular operation, it will possibly be with the supercharged flying-wing squirt type, and then we shall have many new problems as today's classical laws of flow, lift, drag, center-of-pressure travel, and other air force characteristics will no longer apply, and such planes will have to be designed to land and take off safely as conventional types and still fly safely at supersonic speeds.

At such speeds it appears that some phenomenon similar to a disrupted center-of-pressure travel to the rear appears and the conventional trailing edge type of control is not normally effective. Perhaps we shall have to go to controls in the leading edge of the airfoil, or similar changes. In this respect we shall have to be like Alice in Wonderland and be able to go into and out of the looking glass – without getting cut!

■ Helicopter Outlook Appraised

The Sikorsky helicopter and its dramatic demonstrations recently in stability and control bring attention anew to the rotating lift field. Both military development and postwar opportunity have caused many companies to give that field close attention. The rotating lift field seems best suited for the small private owner and similar activities. All the protagonists of this type, de Cierva, Pitcairn, Kellett, and others have felt that rotating was never given the recognition and developmental expense allowance compatible with its opportunity. Most protagonists have felt that properly developed, the rotating lift would come into its best first in the small, slower type vehicle as there are at present certain theoretical limiting speeds and also a limit, with existing materials available, to the practical size of the rotor arm. Actually, a modern pursuit ship which can climb straight up on its propeller, and with the tendency of propellers to get bigger and bigger and for wings to get smaller and smaller, is approaching what we might call the ultimate objective of a helicopter flying on its side. Maybe, paradoxically, some day the two types, now poles apart, will merge on the back side of the universe in infinity.

Another development which should offer great promise is the glider pickup and discharge system. I have always discounted glider trains because, while I could see how gliders were cut off and landed in a practical manner, I could not mentally reverse the process and see how they would pick up in a practical manner. After a demonstration on pickup, I think there is tremendous opportunity for serving small communities without airports, and doing so without danger or seriously slowing down low-flying scheduled flights. Naturally, such pickup is not suitable for supercharged high flying schedules. This development, already well started in airmail, should proceed to broaden its mail field promptly and become of tremendous value when all first-class mail goes by air. From then it should go into air express, and provided pickup accelerations can be kept at reasonable "g's," into passenger travel. Definitely, the glider train idea appears to offer economies in cost per ton mile of goods carried, compared with concentrated loading in the powered plane. How large gliders can be and how many may make an effective train combination, it is too early to say, but our next decade should go a long way to establish this.

Another tremendous development, which was just beginning in the lates thirties and now is almost entirely absorbed by the military, but which will be returned to aviation commerce much enriched, is the whole field of electronics, including communication and indication such as radar. The penetration into shorter and shorter wave lengths now almost approaching infra-red light for communication – both aural and recorded, the improved staticless radio range and direction-finding signals, and the use of absolute altimeters and other radar devices for spotting airplanes in the vicinity are but a few of the opportunities possible. The use of standardized instrument landing devices for permitting landings under all conditions will eliminate uncertainties of terminal weather conditions from the small percentage of flights now affected.

Powerplant improvement is another phase of aviation which is going forward apace these days. A few years ago when the "octane" rating of gasoline antiknock properties was established, 100 octane was considered a perfect antiknock fuel and all fuels were measured against such a rating for antiknock characteristics. Today, for much work 100-octane gasoline is routine and superfuels giving much better performance when utilized with engines designed for their use are available. Sometimes these are called "cocktail" fuels, and with the fine work the engine companies, fuel companies, and other laboratories are doing, I feel certain that today's "cocktail" fuel will be tomorrow's beer and that our engines will continue to increase not only in size but in efficiency and economy.

Whether we go to squirt propulsion or not, our propellers themselves show constant improvement. The new contrarotating types eliminating torque and providing much needed blade areas to improve efficiencies are becoming available.

Progress has created another problem which engineering must consider. It involves assisted take-off acceleration and perhaps landing acceleration. We are constantly running wing loadings higher and higher but airports can't grow much larger than some of the bigger ones are today; so either wing loadings will have to stop, or assisted take-off by gravity, catapult, rocket or other device will have to be developed.

I have mentioned only a few of the engineering thresholds available today. Some are conventional and some are distinctly not. There are many more in both the conventional and unconventional classes, too numerous to mention.

■ What's Ahead?

Let us try to see what these thresholds may lead to within a decade.

First, we shall have a nation and a world which will owe its freedom to air power. Security in the future will be synonymous with the dominance of air power. This in itself will make most people conscious of opportunity. In the United States Army and Navy alone we shall have over 2,000,000 men returning to civilian life, each trained in some phase of aviation and most of them wanting to stay in aviation, or if returning to their previous walks of

turn to p. 39

1944 SAE WAR ENGINEERING Annual Meeting

MONDAY, JAN. 10

MORNING — Transportation and Maintenance

Ordnance Keeps 'em Rolling – What Fleet Men May Learn from Army Tests of Synthetic Tires
– Lt.-Col. B. J. Lemon and Capt. J. J. Robson, Ordnance Department, Tank-Automotive Center

MORNING — Passenger Car

Aircooled Engines in Automotive Vehicles
– Chester S. Ricker, Detroit Editor, Wings

An Informal Long-Range Forecast of Motor Gasoline Developments
– D. P. Barnard, Standard Oil Co. of Indiana, and R. F. Marschner

AFTERNOON — Truck and Bus

What Do Fleet Operators Want in Post-War Trucks?
– Gavin Laurie, Atlantic Refining Co.

AFTERNOON — Passenger-Car Body

The Practical Post-War Car
– E. C. De Smet, Willys-Overland Motors, Inc.

Amphibian Truck Developments
– Col. E. S. Van Deusen, Ordnance Department, Tank-Automotive Center

EVENING — Junior Student

Auspices of Detroit Section

Design Details of Mosquito Bombers
– R. B. McIntyre, De Havilland Aircraft of Canada, Ltd.

TUESDAY, JAN. 11

MORNING — Transportation and Maintenance

Reclamation of Automotive Values
– Norman Hoertz, Thompson Products, Inc.

Reconditioning Brake Drums
– J. V. Bassett, Raybestos-Manhattan, Inc.

MORNING — Aircraft Engine

Synthetic Rubber Applications on Aircraft Engines
– Gertrude Spremulli, Ranger Aircraft Engines

Difficulties with Engines Installed in Civil Aircraft
– Stephen H. Rolle, Civil Aeronautics Administration

AFTERNOON — Materials

Considerations Regarding Post-War Utilization of Aluminum and Magnesium
– L. W. Kempf, Aluminum Co. of America

The General-Purpose Synthetic Rubbers in the Automotive Industry
– A. A. Somerville, R. T. Vanderbilt Co.

Wartime Plastics Applications and Their Peacetime Implications
– Gordon Brown, Bakelite Corp.

AFTERNOON — Aircraft Engine

Aircraft Engine Inlet and Exhaust Porting
– V. C. Young, Wilcox-Rich Division, Eaton Mfg. Co.

Cooling System Performance of Liquid-Cooled Engines
– C. A. Stamm and W. E. McCravey, Chrysler Corp.

A High Altitude Coolant Pump
– E. T. Vincent, University of Michigan

EVENING — Business Session

President Mac Short in the Chair

Nomination and Election of Members-at-Large of Annual Nominating Committee

Announcement of Election of Officers for 1944

Presentation of Amendments to the Constitution

Presentation of Life Membership

EVENING — Passenger Car

Tire and Track Flotation of Military Vehicles
– Lt.-Col. J. E. Engler, Desert Training Command, Camp Seeley

On the Strength of Highly Stressed, Dynamically Loaded Bolts and Studs
– J. O. Almen, Research Laboratories Division, General Motors Corp.

WEDNESDAY, JAN. 12

MORNING — Passenger Car

Winterization of Military Combat, Transport and Other Purpose Vehicles
– R. L. Weider, White Motor Co.

Some of the Problems Presented in L-Head Engines Due to Continued Increase in Compression Ratios
– E. J. Willis, Aluminum Co. of America

MORNING — Aircraft Engine

Low-Cost Cylinder Design for Commercial Airplane Engines
– John P. Flannery, Aircooled Motors Corp.

Aircraft Powerplant Development Testing
– J. O. Charshafian, Wright Aeronautical Corp.

BOOK-CADILLAC HOTEL DETROIT

January 10-14 1944

THURSDAY, JAN. 13

MORNING — Diesel Engine

Diesel Engine Design Trends from War Experience of the U. S. Navy
– E. C. Magdeburger, Bureau of Ships, Navy Department

Development of a Single Plunger Injection Pump for Four-Cylinder Diesel Engines
– Raymond Bowers and R. E. Peterson, International Harvester Co.

MORNING — Aircraft

The Post-War Private Airplane
– W. D. Hall, Aeronca Aircraft Corp.

Post-War Private Flying
– J. H. Geisse, Civil Aeronautics Administration

AFTERNOON — Diesel Engine

Symposium on Chromium-Plated Piston Rings and Cylinder Walls

Porous Chromium for Engine Cylinders
– H. Van der Horst and R. Pyles, Van der Horst Corp. of America

Some Physical and Wear Characteristics of Porous Chromium-Plated Piston Rings
– T. C. Jarrett, American Hammered Piston Ring Division, Koppers Co.

Summary of Technique of Chrome Plating of Cylinder Barrels
– Ballard A. Yates, McQuay-Norris Mfg. Co.

AFTERNOON — Materials

Quality Control of Engineering Materials during Manufacturing and Processing
– R. H. McCarroll and J. L. McCloud, Ford Motor Co.

Effect of Wartime Developments on Future Steels
– W. P. Eddy, Jr., GMC Truck & Coach Division, General Motors Corp.

EVENING — Production

Getting a Better Grip on Quality Control
– John Gaillard, American Standards Association

EVENING

SAE WAR ENGINEERING DINNER

(Limited to SAE members, applicants, and members of the Armed Forces)

A. G. Herreshoff, chairman, Detroit Section

A. T. Colwell, Toastmaster

Mac Short, President SAE

W. S. James, President-Elect

Lessons Learned from Captured Automotive Materiel

MAJOR-GEN. G. M. BARNES,
Ordnance Department

(Gen. Barnes will speak at the invitation of the SAE Truck and Bus Activity)

EVENING — Aircraft and Aircraft Engine

Structural Flight Research
– W. L. Howland, Lockheed Aircraft Corp.

Experimental Flight Testing from the Aircraft Engine Manufacturer's Viewpoint
– L. C. Miller, Wright Aeronautical Corp.

SAE

FRIDAY, JAN. 14

MORNING — Fuels and Lubricants

Symposium on Vapor Lock

A Study of V/L Characteristics of Motor Gasoline and the Application of Vapor Lock Problems in Land Vehicles (Report of Automotive Vapor-Lock Subcommittee of the Coordinating Research Council)
– E. M. Barber, A. E. Robertson and E. W. Aldrich

Cooperative Studies of Fuels and Fuel System Phenomena Contributing to Aviation Vapor Lock (Report of Aviation Vapor-Lock Subcommittee of the Coordinating Research Council)
– R. Albright and A. E. Robertson

Vapor Lock, or Dumb Engineering
– R. J. S. Pigott, Gulf Research & Development Co.

Vapor Lock Tests on Ordnance Transport and Combat Vehicles
– W. G. Ainsley, consultant, Ordnance Department

Altitude Vapor Formation in Aircraft Fuel Systems
– W. H. Curtis and R. R. Curtis, Thompson Products, Inc.

MORNING — Aircraft

Mechanical Characteristics of Plain Low Carbon Steel Sheet and Strip
– H. E. Romine, Carnegie-Illinois Steel Corp.

Rational Design of Fastenings
– E. S. Jenkins, Curtiss-Wright Corp.

AFTERNOON — Fuels and Lubricants

A Laboratory Method for Evaluating Cutting Oils
– H. L. Moir, J. S. Yule, D. J. Wangelin and R. G. Moyer, The Pure Oil Co.

Mobilized Research
– C. B. Veal, secretary, Coordinating Research Council

AFTERNOON — Aircraft

Production Design Changes in the C-47 Airplane
– D. L. Moseley, Douglas Aircraft Co., Inc.

Transoceanic Air Cargo
– Lt.-Com Neil MacCoull, U. S. Naval Air Station, Lakehurst, N. J.

All-Weather Flight Methods
– R. S. Johnson, United Air Lines Transport Corp.

POST-WAR CAR

Small and Economical; Weight Down, Mileage Up

▪ Metropolitan, Oct. 7

(Summary of a paper on the post-war car, by D.G. Roos, Willys-Overland Motors, Inc.)

I SHALL not try to describe or define "the car of the future." I shall rather offer my views on some general aspects.

If we fail to learn some basic truths from this war affecting our problems and future thinking, I think it will be tragic. This war has taught me to regard a gallon of gasoline, a pound of rubber, an ounce of tin almost with reverence – chromium, nickel, molybdenum are not alloys, they are precious metals. If this war has taught us all one thing, it is that if we are to survive as a nation, we must conserve our present supplies of petroleum and add to them as much as possible. Modern war and our economy are built around petroleum.

Our Government, in figuring rationing, assumed an average of 15 mpg for the passenger car. It is perfectly possible, without any added technique or knowledge beyond what we now possess to design a comfortable, roomy, five-passenger car with more performance than is safe for the average citizen, good in appearance, reasonable in cost, that would double this mileage, immediately after the war – weight could be reduced to well under 3000 lb without use of light alloys in any large portion of the structure. Why don't we do it? I suppose because there are no ground rules to the game. Let's imagine a single restriction laid on the passenger-car industry as a whole, as for example limiting engines to 180 cu. in. displacement or less.

What would the effect of such a ruling be? Immense strides would be made toward getting more power and longer life out of smaller engines; lighter cars would be built to take advantage of the limited engine size; the whole design trend would be altered and the engineers' problem would be more clearly defined. I don't recommend such a rule, I merely point out what the effect of the limitation might be.

Will there be any such rules? After the war, it is to be presumed that heavy taxes will be imposed on many things; gasoline, and possibly rubber, will probably be among the items to carry a heavy load. Passenger cars consumed about 18,740,000,000 gal of gas in 1940. We can cut that in half. It is a real challenge to the automobile industry. I believe that the laws of economics and national security will ultimately dictate some such conditions and compel us to design, to conserve not only fuel but precious materials.

I do not look for marked progress immediately from high-octane fuels that depend for their octane rating on tetraethyl lead.

During more than 90% of its life, a motor-car engine is operating on less than 25% load. We have completed tests on our 4-cyl engine to study the effect of 80- and 100-octane fuels at ¼ load.

At the end of 127 hr with 100-octane, 4-cc lead fuel, the lead ash built up on the pistons to the point where mechanical interference stalled the engine. With 80-octane, 3-cc lead fuel, the engine ran about 500 hr before we got into trouble with building up of lead ash. Road tests pretty well support these indications that high-lead fuels cannot be used to advantage immediately after the war.

We could gain in fuel economy by stepping up the compression ratio from 6.5:1 to 7:1. The gains are worth while and can be made with about 75-octane gas. When we go to say 7.5 or 8.1, new problems must be met involving engine noises due to structural deflections and high pressures, but it looks as if substantial gains might be made when some of the above problems are solved.

Aluminum – Not many years ago, aluminum was used very extensively in motor cars. It was dropped in many places because of cost, but not so often because of cost of material as because of cost of labor involved in working it.

Many of the iron and steel items in a car

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Technical IDEAS for ENGINEERS

★★★

Engineers Analyze Outlook and Use of Post-War Fuels

▪ Metropolitan, Dec. 2

IMMEDIATE post-war automobile gasoline may average three octane numbers over the pre-war fuel, with regular grades running about 80 and premium fuels about 85 octane, Bruce K. Brown and D. P. Barnard told the Metropolitan Section Dec. 2.

Assistant Deputy Administrator of the Petroleum Administration for War Brown and Director of Research Barnard, Standard Oil Co. (Ind.), analyzed refinery developments during recent years and pointed out that the nation's high-octane gasoline program is taking the maximum capacity of the industry. This project is being accomplished with complete disregard to:

Economics of operating costs,

Transportation, or

Efficient utilization of crude stocks.

In order to win the war in the air, the authors showed, every facility is being crowded for making high-octane fuels, and although new refinery techniques may be counted upon to produce ever-increasing gains in octane numbers, automobile engineers should not count on any sweeping increases of this type of fuel for several years.

"Improvements above these indicated levels will be *evolutionary* rather than *revolutionary*," they warned.

Vigorous discussion from the floor, in which some members modified and others amplified the prophetic opinions of the authors, followed the presentation of written discussions by four outstanding authorities of automotive engineering and petroleum refining. Several of the written papers presented follow in abstracted form:

Higher Octane Fuels Will Revise Design of Post-War Cars

by CHARLES A. CHAYNE,
Buick Motor Division
General Motors Corp.

(Excerpts from paper entitled "What Will We Do With Post-War Fuels?")

I FOR one, expect higher octane fuels before many years have passed.

Those who agree with me on this point will also conclude that some time during the third or fourth year after hostilities we are going to have new automobile engines.

How are we going to deal with the high forces resulting from the heavier individual impulses in the cylinders?

We must learn to design our engines in the most compact and stiffest form possible. Because we must use the stiffest available materials, lightweight metals will be out of the question.

efed from Papers given at SAE SECTION MEETINGS

57 Reasons Apply to Oil-Change Practice

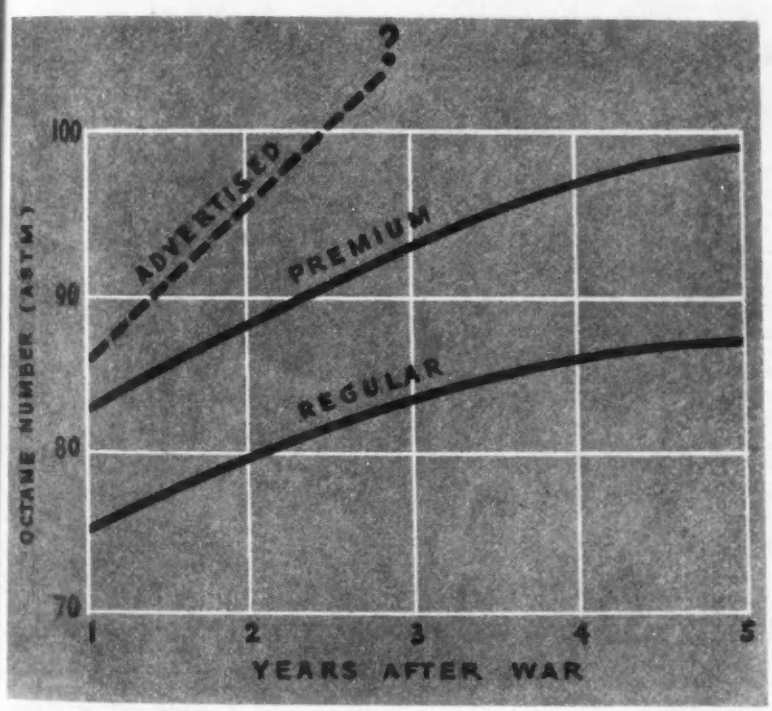
by C. M. LARSON
Sinclair Refining Co.

▪ **Southern California, Dec. 10**

(Excerpts from paper entitled "Crankcase Draining Periods, Plus or Minus.")

WHEN the problem of lubrication is put up to the lubrication engineer and he is asked "when should the crankcase oil be drained," only average mileage or hour periods can be stated. These average recommended periods vary with different engineers, even for the same piece of equipment, because the proper factor of safety needed is always tempered or cut due to oil economy considerations. Generally the physical and chemical changes of the engine oil rather than the mechanical condition of the engine are used as a guide. Thus, a competitive approach is used rather than a meeting of minds whereby the recommendations of draining crankcases of different installations are made on the basis of a custom-made analysis using four factors – operation, maintenance, design, and oil quality.

turn to p. 51



How the post-war prospects for high-octane gasoline look to Charles A. Chayne, chief engineer, Buick Motor Division, GMC

We must deal with higher *peak* pressures when that time comes, and cannot depend wholly upon solving the *mean* pressure problems. A good pre-war automobile engine has peak pressures in the neighborhood of 600 psi, but aircraft engines run from 1000 to 1200 psi peak. Modern 100-octane airplane engines cost 10 times as much per hp as a car engine, but none is sufficiently smooth to try to sell to a car owner.

Some of the design problems faced by automobile engine engineers:

Combustion chamber volumes must be held to closer limits which will require a great deal of work on redesigning a lot of parts – heads, blocks, pistons, connecting

turn to p. 52

Field and General Officers Training In Vehicle Upkeep

by JOHN B. CLARK, WILLIAM H. RHODES and TOM GLUCK
Civilian Automotive Advisers, U. S. Army

▪ **Southern California, Nov. 12**

(Excerpts from paper entitled "The Services of the Civilian Automotive Adviser.")

WHEN the War Department felt that it was necessary to acquire the services of a sufficiently large group of experienced fleet executives and automotive technicians to carry out a training program in the operation and maintenance of its vehicles, a temporary Civil Service expedient was adopted, and the task of furnishing the Army with civilian automotive advisers got under way.

Preliminary selection of qualified applicants was made in various sections of the country by interviews with leading transportation men. Those accepted were expected to start to work at once.

Because of the newness of the problem involved in developing our present motorized army, few field officers have ever had the opportunity to learn even the simpler principles of automotive operation and maintenance. However, since transportation is one of the essential ingredients of an effective fighting force, Ordnance Motor Transport Schools have been set up, in which field and general officers are given a short and intensive course which highlights the principles of automotive operation and maintenance, with special emphasis on preventive maintenance. After returning to their commands, the officers are expected to continue the work "on their own," taking advantage of the available sources of information, such as the motor officer and civilian adviser.

The increased knowledge of preventive maintenance at the top of the unit has done more than any other single step to enable the civilian adviser to make his work effective. Ordnance is also operating special motor transport schools for junior officers, as well as a number of specialized courses for mechanics. Since they can accommodate only a fraction of the men who must be trained, it is necessary to set up training machinery within each unit to care for the hundreds who cannot get to Ordnance schools. There are also many phases of motor pool organization, management, and enforcement which are difficult to teach effectively in school, but which can be learned readily on the job.

The army technical training manuals and other publications and training aids in the field of motor transportation and maintenance have become part of the tools.

Mechanics' schools within the unit can best be handled by setting aside a definite period of each working day for training purposes. By making the lessons short, the mechanic gets a better grasp on what he is taught, and he is not taken away from his regular daily work.

Versatile American Warplanes Proved in Battle; Bomb Loads And Accuracy Reach New Peaks

▪ Detroit, Nov. 15

(Summary of a talk on Modern American Combat Airplanes in the War by Brig-Gen. F. O. Carroll, Materiel Command, AAF)

PERFORMANCE, armament and effectiveness of American airplanes now active in combat theaters, as well as some of the more advanced experimental types of aviation devices and airplanes were topics of discussion in Brig.-Gen. F. O. Carroll's talk on the trend in aircraft design.

The brunt of today's combat is carried on by four bombers – the B-17 Flying Fortress, B-24 Liberator, B-25 Mitchell and B-26 Marauder; and by four fighters—the P-38 Lightning, P-39 Airacobra, P-40 Curtiss and P-47 Republic, Gen. Carroll said. The B-29 Boeing superbomber, a light bomber (in three special versions), a P-51 North American and a new night fighter are types which are forthcoming, he disclosed.

Cites Design Changes

The general described the B-17's growth from a plane with 800 hp engines to one carrying 1200 hp engines, with guns increased from five to as many as 12 or 16, and with gross loads increased from 34,000 lb to 65,000 lb to meet wartime needs. He told, too, about the accuracy of pinpoint bombing, stating that our bombardiers not only pick out individual factories as small as one city block in area, but actually single out individual buildings in the area for their bombings.

The damage done in some of these raids, such as those on the fuel installations at Ploesti, required the payment of a big price in aircraft and personnel, he said, but the destruction was as much or more than what 10 full divisions on the ground could have accomplished.

Load Distribution Varies

A tendency to disregard center-of-gravity location is frequently observed in the field, Gen. Carroll indicated. Crews will carry two or three times their nominal allotments of ammunition because they are anxious to do a thorough job on the enemy. Each crew member wants his ammunition close to him, and the result is a poor distribution of load.

The B-25 and B-26 bombers were put in production without most of the usual tests, the speaker revealed. Designs were initiated in 1939 and some of the airplanes were in the air in November of 1940. The need was urgent, he stated, because in 1939 the services had few airplanes – "it would scare you to know how few," he declared.

The P-38 is rated as the most versatile high-altitude fighter, having exceeded 40,000 ft. It carries its guns mounted close together in the nose so it literally bores through enemy aircraft with a "bar of steel." It has been used for dive bombing and many other tactics.

The P-39, a radical departure in aircraft design, is a major contribution to air-ground support, as used by the Russians. The airplane has been rated the best on the eastern front.

The P-40, used variously as a low-altitude fighter and bomber, has "probably shot down more enemy aircraft than any other airplane."

The P-47, long range, heavy-hitting fighter, is one of the newest operational types. Even more range is incorporated in the latest of this type.

The Design Section at Wright Field is keeping ahead in the technological race, Gen. Carroll informed the audience, adding that heavier bombers, more deadly fighters and larger transports are part of the picture. The whole concept of aircraft requirements has changed as the war has changed from defense to offense. Changes will continue to be made because we cannot afford to make the assumption that the war has been won until it is actually ended.

Of freezing designs, Gen. Carroll said, "Freezing is a grand idea if you are sure you are going to win the war in the first summer; the Nazis *were* sure!"

WANTED...

Periodicals for Foreign Libraries

COPIES of the SAE Journal and Transactions, as well as other technical and scientific journals, are wanted for libraries and institutions in Europe and Asia not now able to receive them because of the war. The American Library Association has a committee to collect and store material for this purpose. If you wish to give your copies, please write to Dorothy J. Comins, Executive Assistant, Committee on Aid to Libraries in War Areas, Library of Congress Annex, Study 251, Washington 25, D. C.

Diesel-Powered Plane Makes Dayton-to-Dallas Flight at Fuel Cost of Below Penny-Per-Mile

by W. E. LIND
Guiberson Diesel Engine Co.

▪ Northern California, Nov. 9

(Excerpts from paper entitled "Evolution, Design and Engineering Features of the Guiberson Model T-1020 Engine.")

THE Model T-1020 diesel engine for use in a vehicle is a self-cooled powerplant. Air pressure generated by the fan is retained by the cowling and directed around the cylinder head and cylinder barrel as a cooling medium. The fan is direct connected to the crankshaft and rotates at engine speed. The flywheel is designed to receive a clutch and pilot bearing.

The general specifications for this engine may be briefly outlined as follows:

Type: radial, aircooled diesel, 4-stroke cycle	
Number of cylinders	9
Compression ratio	14.5:1
Bore, in.	5.125
Stroke, in.	5.500
Displacement, cu in.	1021
Maximum power, net output	210 bhp at 2200 rpm
Dry weight, bare engine, lb	707
Dry weight, complete unit, lb	990

There are several types of starters for the engine: the Breeze-Coffman combustion type; the Eclipse inertia electric; and electric continuous drive.

Starter Mounting

The rear accessory case is provided with a starter mounting flange, and a driving jaw is provided at the rear of the crankshaft.

In consideration of the size of the engine, the cranking torque is low. At a temperature of zero the breakaway and cranking torque are almost the same with values at 80-100 lb-ft.

The cooling fan of an aircooled engine is important in that it must not only generate the static pressure required for cooling the engine, but should do so with the least possible expenditure of power. Secondary only to the fan is the necessity of maintaining the desired direction of airflow in the actual engine compartment. Uncontrolled turbulence at the rear of the engine can completely reverse the airflow over some section of the cylinders. However, with the help of air conditioning knowledge, almost any shape of engine compartment can be reasonably controlled.

Pressure Lube System

Pressure lubrication is supplied to the engine through a hollow crankshaft, and also to the valve tappet lifters which meter a small quantity of oil to the valve rocker arms.

The combustion chamber is a simple open-chamber type with a horizontal fan-shaped spray pattern; the piston is a full-trunk type made from an aluminum-alloy forging; the cylinder barrel from pierced steel forging; the cylinder head is an aluminum-alloy casting; the injector is of the hydraulically operated differential type; and the fuel injection pump is of an inlet port restriction metering type.

A few words about the economy of a diesel powered plane would be of interest.

The prototype A-1020, 310-hp, 9-cyl radial aircooled engine is installed in a SR-9 Stinson airplane. During a recent trip between Dallas and Dayton, at an average speed of 109.3 mph. this engine consumed 205 gal of fuel. The average cost of the fuel used during this trip was 7.3¢ per gal. The total cost of the fuel for the trip was $15.04. The plane averaged 8.3 miles per gal, which is less than one cent per mile.

COOLING-SYSTEM MAINTENANCE

(Including Cleaning, Flushing, Rust Prevention, and Antifreeze)

PART I

A. Preventive Cooling-System Maintenance

Every commercial vehicle operator should carefully restudy his cooling-system maintenance methods, particularly in the light of present war emergency conditions of discontinuance of motor-vehicle production for civilian use, shortage of replacement parts and labor, and increasing demand on existing vehicles for essential services connected with the war effort.

Preventive cooling-system maintenance service, in the real sense of the word, should be practiced. For example, overheating of the engine from loss of cooling liquid should be avoided by preventive inspection and servicing for leakage and overflow losses rather than by continually adding water or valuable antifreeze. Likewise, the problem of rust-clogging and corrosion damage should be eliminated by the prevention of corrosion rather than by the correction of rust-clogging through clean-out methods or the replacement of damaged parts containing critical materials after the cooling system is in trouble. (See Fig. 1.)

Generally speaking, preventive cooling-system maintenance never has been up to the standard of service for other units of the vehicle. It is, therefore, all the more important that a higher standard should be set and constantly maintained during these critical times to prevent conditions of neglect that otherwise will result in gasoline wastage, lubricating difficulties, and excessive wear or damage of the engine from either overheating or overcooling.

The importance of maintaining the automotive cooling system as close as possible to new-car efficiency at all times can be appreciated if it is realized that even in the smaller engines the amount of heat which must be dissipated through the cooling liquid and radiator is sufficient to heat a six-room house on a zero day. The amount of water pumped at high speed in such an engine would fill a 50-gal drum in 60 sec. Complete failure of cooling for any reason means dangerous overheating of the engine in a few minutes. Proper cooling contributes more to continued engine operation and long life than is generally realized. Many expensive road failures are caused by the simplest irregularities that very often could have been detected and corrected through a few minutes' close inspection before the vehicle left the shop.

B. Preventive Inspection

The suggested tests which follow have all been used in actual maintenance, but are not intended to be mandatory. The condition of each individual vehicle should determine if any or all tests are needed. Which tests are necessary, desirable, or possible must be left to the judgment of the vehicle operator.

B-1. Inspection for Cooling-Liquid Losses – Considering the engine damage which can result from overheating

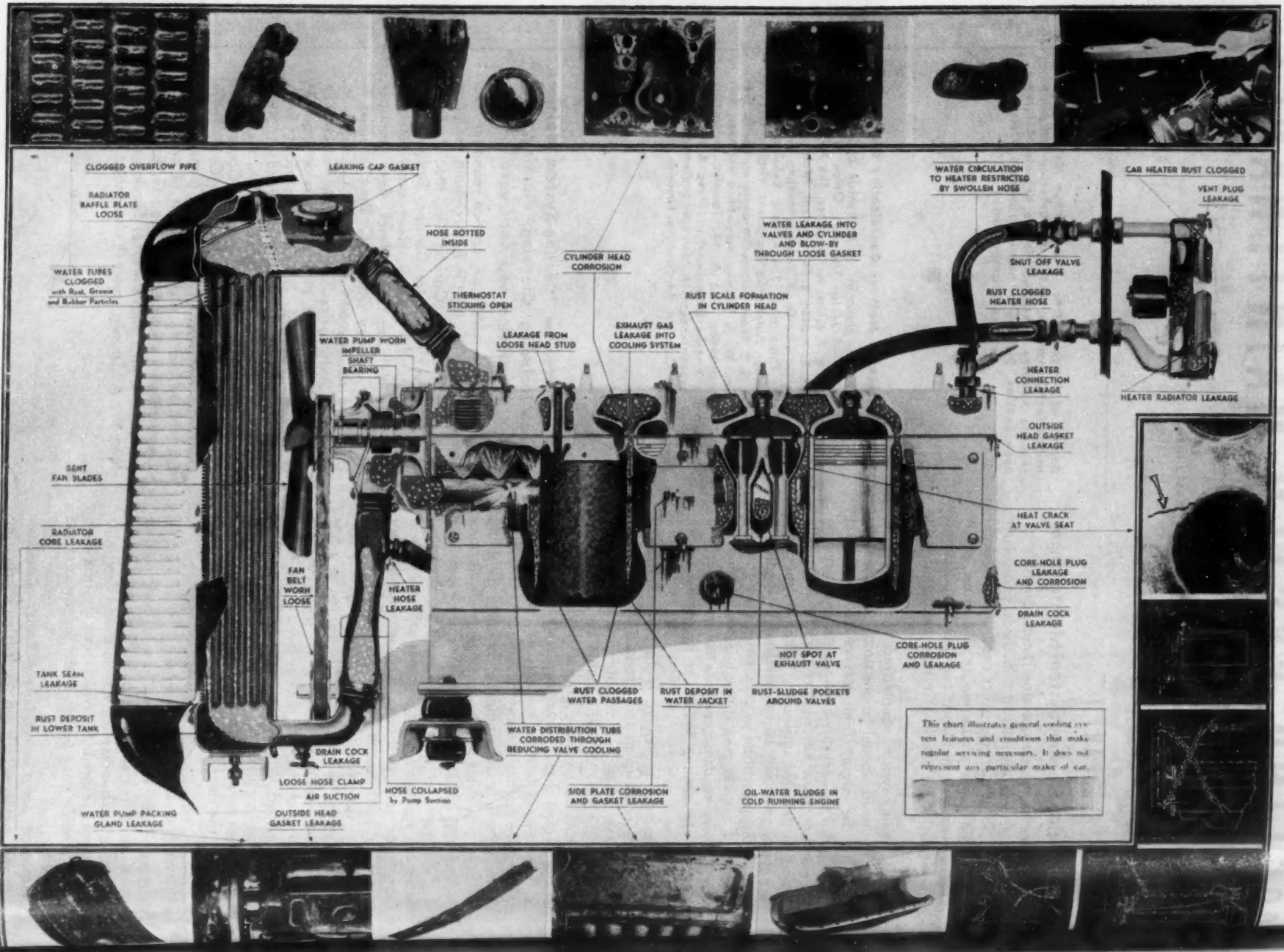
Report of Subcommittee, Maintenance Methods Coordinating Committee, SAE Transportation and Maintenance Activity, Submitted to the Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation

SAE Maintenance Methods Coordinating Committee

W. J. Cumming, chairman, chief, Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation; E. P. Gohn, test engineer, The Atlantic Refining Co.; M. E. Nuttila, superintendent, Motor Vehicles, Cities Service Oil Co.; G. W. Laurie, manager, Automotive Transportation Department, The Atlantic Refining Co.; J. Y. Ray, supervisor, Automotive Equipment, Virginia Electric & Power Co.; S. B. Shaw, automotive engineer, Pacific Gas & Electric Co.; W. A. Taussig, automotive engineer, Burlington Transportation Co.; E. W. Templin, automotive engineer, Los Angeles Department of Water & Power; D. K. Wilson, superintendent, Automotive Equipment, N. Y. Power & Light Corp.; A. M. Wolf, automotive consultant.

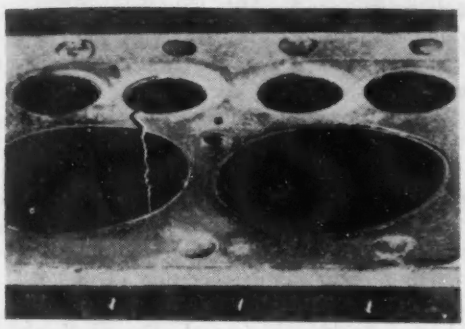
Subcommittee on "Cooling-System Maintenance – Including Cleaning, Flushing, Rust Prevention, and Antifreeze"

D. H. Green, chairman, service manager, National Carbon Co., Inc.; F. R. Archibald, technical supervisor, National Carbon Co., Inc.; J. Askin, chief engineer, Radiator Division, Fedders Mfg. Co., Inc.; J. D. Bradley, fleet superintendent, American Ice Co.; E. Chadwick, fleet manager, Little Falls Laundry Co.; H. C. Duus, chemist, E. I. duPont de Nemours & Co.; L. R. Gwyn, Jr., engineer, Automotive Department, Railway Express Agency, Inc.; E. N. Hatch, service engineer, American Brakeblok Division, American Brake Shoe Co.; W. R. Herfurth, superintendent, Automotive Equipment, R. H. Macy & Co., Inc.; J. J. McCarron, superintendent, Garage, Consolidated Telegraph & Electrical Subway Co.; C. E. Smith, shop superintendent, Burlington Transportation Co.; H. M. Smith, superintendent of equipment, Connecticut Railway & Light Co.; G. E. Stewart, parts manager, United Parcel Service of N. Y., Inc.; W. A. Taussig, project chairman.


CLOGGED OVERFLOW PIPE
LEAKING CAP GASKET
RADIATOR BAFFLE PLATE LOOSE
HOSE ROTTED INSIDE
WATER TUBES CLOGGED with Rust, Grease and Rubber Particles
CYLINDER HEAD CORROSION
WATER LEAKAGE INTO VALVES AND CYLINDER AND BLOW-BY THROUGH LOOSE GASKET
WATER CIRCULATION TO HEATER RESTRICTED BY SWOLLEN HOSE
CAR HEATER RUST CLOGGED
VENT PLUG LEAKAGE
SHUT OFF VALVE LEAKAGE
RUST CLOGGED HEATER HOSE
THERMOSTAT STICKING OPEN
RUST SCALE FORMATION IN CYLINDER HEAD
WATER PUMP WORN IMPELLER SHAFT BEARING
LEAKAGE FROM LOOSE HEAD STUD
EXHAUST GAS LEAKAGE INTO COOLING SYSTEM
HEATER CONNECTION LEAKAGE
HEATER RADIATOR LEAKAGE
OUTSIDE HEAD GASKET LEAKAGE
DENT FAN BLADES
HEAT CRACK AT VALVE SEAT
RADIATOR CORE LEAKAGE
CORE-HOLE PLUG LEAKAGE AND CORROSION
FAN BELT WORN LOOSE
HEATER HOSE LEAKAGE
DRAIN COCK LEAKAGE
HOT SPOT AT EXHAUST VALVE
CORE-HOLE PLUG CORROSION AND LEAKAGE
TANK SEAM LEAKAGE
RUST CLOGGED WATER PASSAGES
RUST DEPOSIT IN WATER JACKET
RUST-SLUDGE POCKETS AROUND VALVES
RUST DEPOSIT IN LOWER TANK
WATER DISTRIBUTION TUBE CORRODED THROUGH REDUCING VALVE COOLING
DRAIN COCK LEAKAGE
LOOSE HOSE CLAMP
AIR SUCTION
HOSE COLLAPSED by Pump Suction
SIDE PLATE CORROSION AND GASKET LEAKAGE
OIL-WATER SLUDGE IN COLD RUNNING ENGINE
WATER PUMP PACKING GLAND LEAKAGE
OUTSIDE HEAD GASKET LEAKAGE
This chart illustrates general cooling system features and conditions that make regular servicing necessary. It does not represent any particular make of car.

when a vehicle is driven with insufficient liquid in the cooling system, the maintenance of proper liquid level in the radiator is of first importance. Contrary to the popular belief, evaporation of water or antifreeze solutions accounts for only a small part of cooling-liquid losses. Large-scale driving tests have proved that, on the average, at least half of all the cooling-liquid loss from a system is due to leaky parts, and that most of the other half is *liquid* loss through the radiator overflow pipe from boiling, foaming, and so forth. Only by careful preventive inspection can motor-vehicle operators avoid the trouble and expense of replacing cooling-liquid losses and the hazards of overheating damage from shortage of cooling liquid. (See Fig. 2.)

The level of cooling liquid in the radiator is the focal point of preventive cooling-system maintenance, and is just as important as the oil level in the crankcase.



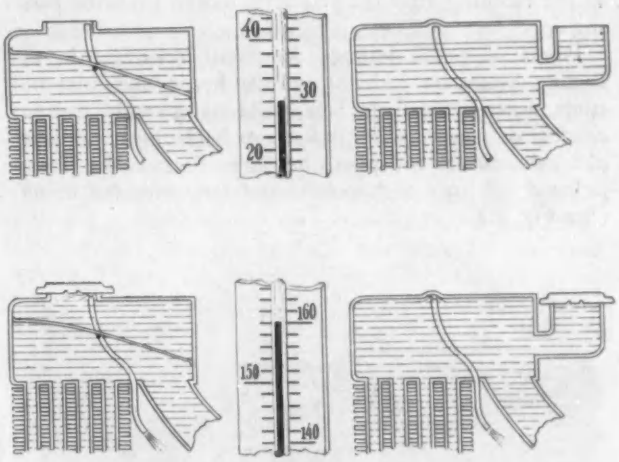
▪ Fig. 2 – Cracked engine block – typical of damage from overheating

B-2. Liquid Level in Radiator – The first check on coolant losses is the inspection of the liquid level in the radiator. This should be performed daily. Whenever possible it should be done when the liquid is heated up to driving temperature and after the engine is stopped. A convenient time to check the level in the radiator is when the vehicle is put up at the end of the day or working shift. The reason for stopping the engine before checking the liquid level is to permit the escape of any air or gas that might have become entrained or mixed with the liquid during operation. Air or gas entrained with the liquid gives a false high level in the radiator which drops when the engine stops and circulation of the liquid ceases.

Caution: Do not use a match or other open flame when inspecting the liquid level in the radiator.

Both water and antifreeze solutions take up more room in the cooling system when hot than when cold. If the radiator is filled too full when cold, expansion when hot will overfill the radiator and liquid will be lost through the overflow pipe. Adding unnecessary water weakens antifreeze solutions and eventually leads to a freeze-up. In many vehicles it is impossible to see deeply into the radiator due to the design and location of baffle plates or elbow filler necks, and if a service man checks the solution when it is cold, he may not be able to see it and may think it is low when it really is not.

It is advisable to avoid making any additions of cooling liquid as long as the hot level is well above the top of the radiator tubes or is in sight through the radiator filler opening. Because of the many different designs of cooling systems, it is not possible to set a universal standard for liquid level that will apply to all makes of vehicles. However, in any vehicle, the hot liquid level should be sufficiently far below the top of the overflow pipe, with the engine stopped, to ensure that no liquid will overflow under conditions of driving. Vehicle manufacturers' directions should be followed for proper height of liquid level. (See Fig. 3.)



▪ Fig. 3 – Above: showing overfilling of radiator when solution is cold; below: showing how solution is lost through overflow pipe by heat expansion when too much water is added with solution cold

B-3. Inspection for Leakage – It is not safe to assume that daily losses of cooling liquid are evaporation losses. Even when the amounts are small, they warrant an immediate investigation of the cause, and the possibility of leakage should never be overlooked. Leakage of only 1 drop of liquid per min means 1 gal of antifreeze solution lost in 6 weeks. Leakage of the cooling system is probably more prevalent than of any other liquid-carrying unit in the vehicle, due to the stresses and strains set up in joints and connections by wide changes in engine temperature, especially during cold weather; vibrations from operation of the engine and movement of the vehicle; deterioration of gaskets; and wear, breakage, or corrosion perforation of metal parts. Leakage is thought to be the most common trouble in the cooling system itself.

To detect small leaks at their inception, inspection should be made with the cooling system cold, preferably before the vehicle is put into operation for the day. Small leaks which may show dampness or even dripping when cold can easily escape detection when the engine is hot, due to rapid evaporation of the leakage. This is particularly true of water and alcohol antifreeze solutions. High-boiling-point antifreezes of the ethylene-glycol type evaporate more

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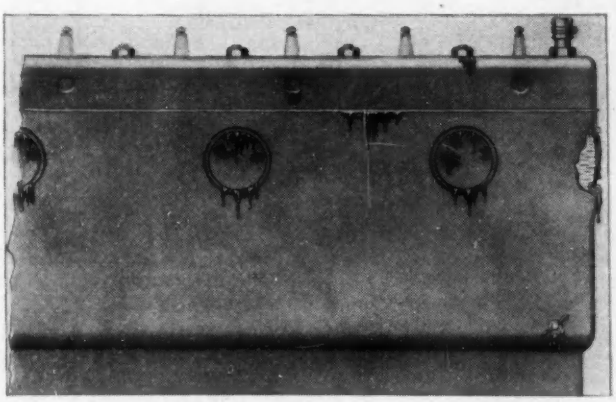
▪ Fig. 1 – Automotive cooling system, showing points where trouble may result from neglect of cooling-system service

slowly, and any existing leakage of their solutions is, therefore, easier to find. Telltale stains of grayish-white or rusty color, or dye stains from antifreeze, at joints in the radiator or engine water jacket are almost always sure signs of small leaks even though there appears to be no dampness. These stains are usually corrosion products from the cooling system, which have been carried through the leaking crevices and left behind when the cooling liquid has evaporated.

Certain parts of the cooling system are difficult to inspect for leakage, such as the rear of the engine water jacket, some drain-plug locations, the front side of the radiator in the newer cars with grilles, the underside of the radiator bottom tank, and the water-pump seal, which in some cases is practically covered up by the driving pulley. Because of the inaccessibility of these points to leakage inspection, it is advisable to locate vehicles overnight on a clean floor surface, and then inspect the floor for wetness in the morning after the vehicle is moved from the parking spot.

Points of liquid leakage commonly occurring in the cooling system are: radiator, cylinder-head-gasket joint and studs, water-pump shaft, hose connections, engine castings cracked or porous, water-jacket core-hold plugs and cover plate, thermostat and pump housings, drain cocks, water-jacketed oil lines and coolers, and hot-water car heater. (See Fig. 4.)



■ Fig. 4 – Outside leakage of engine water jacket

B-4. Pressure Testing for Cooling-System Leakage – Inspection for liquid leakage may not detect leaks above the liquid level in the radiator. The application of vacuum or pressure to the cooling system by mechanical means requires experience and care to avoid damage and special pressure control equipment is necessary. A simple test for airtightness can be made, with the cooling system cold, by sucking on a rubber tube attached to the overflow pipe and then applying the tongue to the end of the tube. If the tongue adheres to the tube, the system may be considered reasonably airtight. For personal safety reasons, getting cooling liquid or antifreeze solution in the mouth always should be avoided. In sealed systems, the radiator-cap pressure valve must be blocked open while making this test.

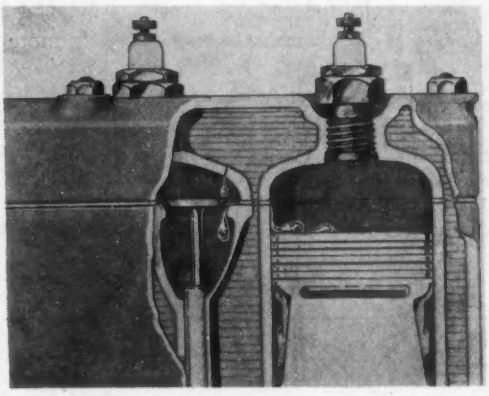
B-5. Internal Leakage of the Engine Water Jacket – While outside leakage of the cooling system, if neglected, introduces the immediate hazard of overheating from low cooling liquid, *inside* leakage of the water jacket into the crankcase and moving parts of the engine can be even more serious in its consequences. Common points of internal leakage are: loose cylinder-head-gasket joints, thread leakage of loose cylinder-head studs or bolts, seal leakage of wet-type cylinder sleeves, porosity or cracks in the cylinder head or block, and loose or broken joints in oil coolers or oil lines in contact with the cooling liquid.

Either water or antifreeze solution leakage into the engine is detrimental to lubrication, and either liquid mixed with the engine oil in sufficient quantities will form sludge which may cause lubrication failure, sticky piston rings and valves, excessive wear, and extensive engine damage if driving is continued. Appreciable quantities of water and antifreeze may be removed by crankcase ventilation and do no harm in warm weather but may cause serious engine trouble during cold-weather driving. For this reason, a preventive check for internal leakage should preferably be made in the fall of the year, as a regular part of a winter maintenance program. (See Fig. 5.)

B-6. Service Tests for Internal Engine Leakage – Checking for internal leakage of the engine water jacket is not as simple as inspection for outward leakage of the system. However, there are several tests which, if performed regularly, will detect most internal leakage before it reaches the serious stage. These tests are made as follows:

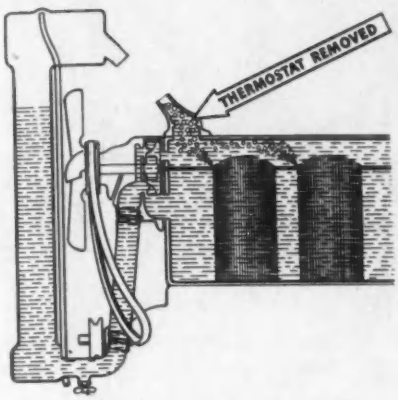
1. Start with the engine cold, first removing the fan belt from the drive pulley, or disconnecting the water-pump coupling, to prevent pump operation. Drain the system until the coolant is level with the top of the engine block, but no lower. Remove the upper radiator hose, thermostat housing, and thermostat. Replace the thermostat housing and fill with water; or, with the housing removed, fill the water jacket completely.

With the engine in neutral gear, "gun" it several times, watching for bubbles in the water opening while gunning, and also when the engine drops back to idling. To detect the smaller type of leaks, jack up the rear wheels of the car, run the engine at higher speed in high gear, and load it gradually and intermittently by the use of the foot brake. Appearance of bubbles or the sudden rise of liquid indicates leakage of exhaust gas into the cooling system. Injecting suitable light oil into the carburetor while testing sometimes helps to identify exhaust gas leakage by pro-



■ Fig. 5 – Liquid leakage into engine

ducing smoke in the bursting bubbles. Make the test quickly before boiling starts since steam bubbles give misleading results. Even a small amount of exhaust gas leakage into the cooling system should be corrected immediately, since the indicated gas leak may eventually permit liquid to enter the engine if it is not already doing so. (See Fig. 6.)



■ Fig. 6 – Checking for exhaust gas leakage

2. Using an adaptor, apply air pressure (about 100 psi) through each spark-plug hole with the piston at top dead center on the compression stroke. Air leakage from the cylinder will be indicated by air bubbles or a rise of liquid in the radiator or in the engine water outlet if the upper hose is disconnected. This is also a useful test for valve leakage.

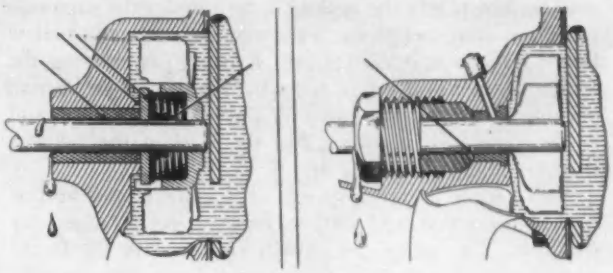
3. The "smell" test, made at the radiator filler opening, is reported to be of value, since exhaust gas leakage into the cooling system seems to give the cooling liquid a distinctive odor.

B-7. Inspection for Water-Pump Leakage – It should be pointed out that a pump-seal leak which is dripping with the engine stopped or idling may not show up at all with the engine running at moderately high speed, for the reason that the suction of the running pump will draw air in at the leak and thus prevent liquid from running out. This same condition exists at all points of leakage on the suction side of the water pump, including heater hose connections to the engine and car heater, lower hose connections between pump and radiator, lower tank of the radiator, and even at leaks in the lower portions of the radiator core. (See Fig. 7.)

B-8. Service Test for Air Suction into System – Since water-pump leakage cannot always be detected by casual inspection, a special test may be necessary. The following quick check for leaks on the suction side of the water pump usually requires no other equipment than a piece of tubing and a glass bottle containing water.

To make this test, first adjust the liquid level in the radiator, allowing room for expansion when hot, so as to avoid any overflow loss during the test. Be sure the radiator cap is on tight. With pressure caps, block open the pressure valve or replace with a plain cap.

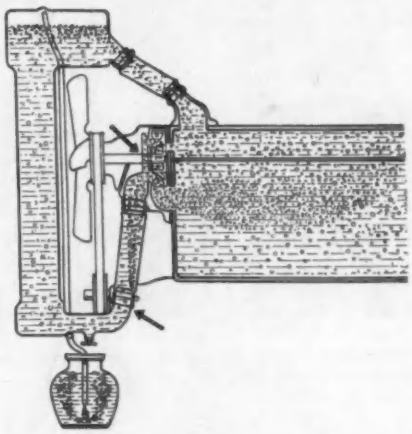
Attach a suitable length of rubber hose to the lower end of the overflow pipe. All connections must be airtight.



■ Fig. 7 – Points of leakage in two types of water pumps: left, in "packless" type pump seal; right, in adjustable gland-type pump seal

Run the engine in neutral gear at a safe high speed until the dash indicator stops rising and remains stationary; in other words, until the engine reaches a constant operating temperature. Without changing the engine speed, put the free end of the rubber tube into a bottle of water, avoiding kinks and low bends that might block the flow of air. Watch for bubbles in the water bottle.

In the absence of exhaust gas leakage into the cooling system, a continuous flow of bubbles indicates that air is being sucked into the system. Any leak on the low-pressure side of the pump, which will permit air to be drawn in at high speed, will eventually allow liquid leakage with the engine idling or stopped, if liquid leakage is not already present. (See Fig. 8.)



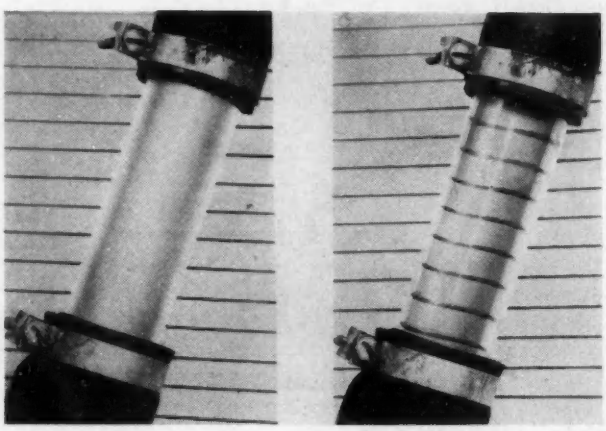
■ Fig. 8 – Checking for air suction

B-9. Overflow Loss from Air or Gas Entrainment in Cooling Liquid – As previously stated, during operation of the engine at higher speeds, suction of the water pump will draw air into the system through leaks at the pump seal or at other points of leakage on the low-pressure side of the pump. This air is circulated with the cooling liquid and increases the volume of the liquid in the system, causing the level to rise in the radiator. Entrained air, in sufficient quantities, causes large overflow losses of cooling liquid while the vehicle is being driven.

In the case of an internal water-jacket leak, exhaust gas may be blown into the cooling system under the explosion pressures, even though the leaks may be too small to allow liquid leakage into the engine. Exhaust gas entering the cooling system will act in the same manner as air suction into the system from the pump. The volume of the liquid in the system is increased, and the level in the radiator may rise to the overflow point.

With reduced engine speed, air suction ceases, and at low engine speed and output, exhaust gas leakage may diminish. The air or gas already entrained in the liquid escapes to the air space in the upper radiator tank, causing the level in the radiator to drop. Therefore, an inspection of the liquid level with the engine idling or stopped will not reveal the abnormally high level prevailing with the vehicle running.

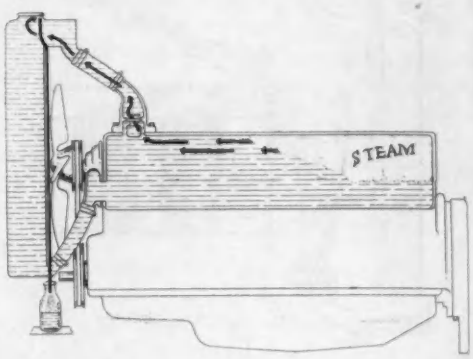
B-10. Method for Observing Air or Gas in Cooling Liquid – Air or gas entrainment in the cooling liquid may be readily observed through a glass tube installed in the upper hose. A section of the hose is cut away and the glass tube is inserted and secured to the hose ends with suitable clamps. With the engine running at the higher speeds, any air or gas in the cooling liquid appears as bubbles passing upward in the tube. Finely divided bubbles, indicating foaming, will impart a milky appearance to the liquid. To avoid confusing exhaust gas or air bubbles with steam, the temperature of the cooling liquid should be kept well below its boiling point during the test. (See Fig. 9.)



■ Fig. 9 – Detection of gas entrainment with glass tube: left, aerated coolant; right, air-free coolant

B-11. Overflow Loss from Local Boiling in Water Jacket – Fleet operators seem to be in agreement that overflow losses from hot spots and local boiling in the engine water jacket are quite general conditions. When the engine is slowed down or stopped after driving, steam pressure in the water jacket forces cooling liquid into the radiator until it overflows. This phenomenon is commonly known as afterboil. Common causes of hot spots are rust and scale clogging the water passages in the jacket, especially between cylinders and around the exhaust valves. (See Fig. 10.)

B-12. Service Test for Overflow Loss of Cooling Liquid – The detection of overflow loss of cooling liquid must be made while the vehicle is being driven or immediately after it is stopped. For accurate checking of overflow losses, a catch pot in the form of a gallon can or glass jug on the radiator overflow pipe is indispensable. The catch pot is located at a point below the normal solution level in the radiator and is connected to the radiator by a tube attached to the overflow pipe. Kinks and low bends in the overflow tube must be avoided, and the end of the tube must not extend into the catch pot more than an inch,



■ Fig. 10 – Overflow loss from overheating and boiling

while the catch pot must be open to the atmosphere. A convenient installation is a 1-gal glass jug located on the floor of the vehicle below the instrument panel and visible from the driver's seat.

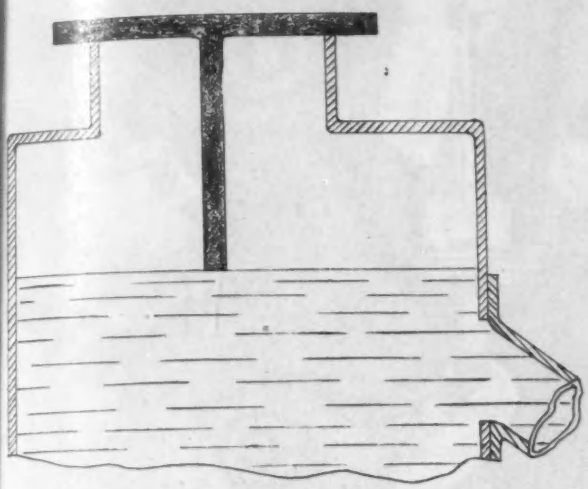
Before making a test run with the vehicle, the solution level must be adjusted with the engine at driving temperature so as to eliminate the possibility of overflow loss from overfilling and thermal expansion during the test. During the test run, the vehicle should be driven under customary conditions of speed and load for sufficient distance (not less than 5 miles) to obtain maximum engine operating temperature, following which the vehicle should be decelerated and stopped and the engine shut off, in accordance with regular driving practice. After repeating this procedure a few times, any overflow of cooling liquid which has collected in the catch pot should be measured to determine the amount of loss from the system through overflow for a given driving period.

Driving overflow losses should always be kept down to the absolute minimum. Certainly a vehicle which requires additions of liquid during a normal driving shift should be put in the shop for detection and correction of the cause. One operator of large buses makes a practice of putting vehicles into the shop for inspection and servicing if the cooling system requires more than 2 qt to be added per day.

B-13. Suggestions for Maintaining a Standard Liquid Level in Radiator – 1. In larger fleets where it may not always be practicable to check the liquid level at top engine driving temperature, a standard level at a lower temperature may be established. For the purpose of maintaining a standard liquid level at any established temperature, a simple home-made gage can be prepared in the form of a T. With the horizontal member of the T resting on the top of the filler neck opening, the vertical member is of

such length as just to touch the liquid at the standard level. (See Fig. 11.)

2. Due to long, curved, or offset fillers in rear-engined buses and cab-over-engine trucks, visual inspection of solution level is often impossible. In such cases, a satisfactory method of checking the level has been obtained by installing a petcock on the side of the top radiator tank at a previously determined standard liquid level and temperature. With the petcock open, the liquid level is adjusted to the point where liquid starts to run out the petcock, after which, of course, the petcock is closed.



■ Fig. 11 – Radiator liquid level T gage

3. An inexpensive water-sight gage installation on a cab-over-engine vehicle is illustrated in Figs. 12 and 13. Reports on this installation indicate that it has been effective in reducing water additions to the system. This type of installation has the advantage of accessibility for inspection of cooling liquid condition, for filling, and for antifreeze testing.

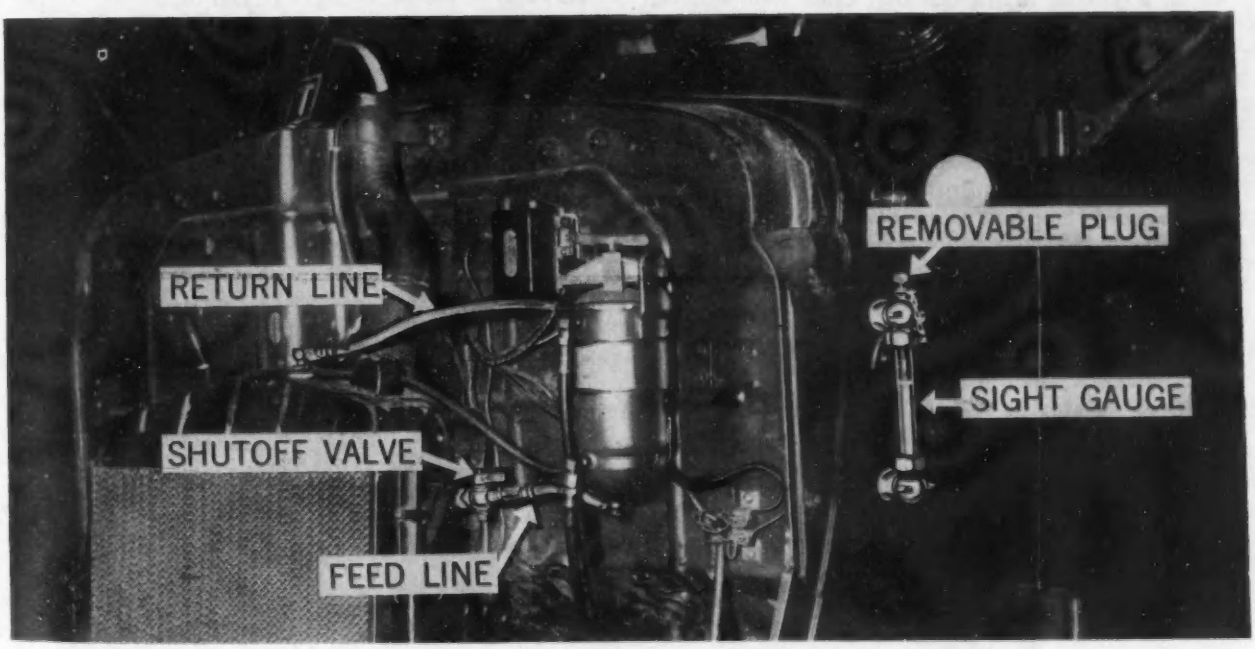
Even when using water only, during warm weather or in vehicles regularly parked in heated garages, overfilling should always be avoided. Nearly all water supplies contain some dissolved minerals which have a tendency to precipitate and form scale deposits in the system, especially at any hot spots in the engine water jacket. Another reason for adding to the system as little water as is consistent with proper circulation and cooling is to avoid the loss of corrosion protection from thermal expansion and overflow, when using a corrosion inhibitor in the water.

■ C. Routine Maintenance

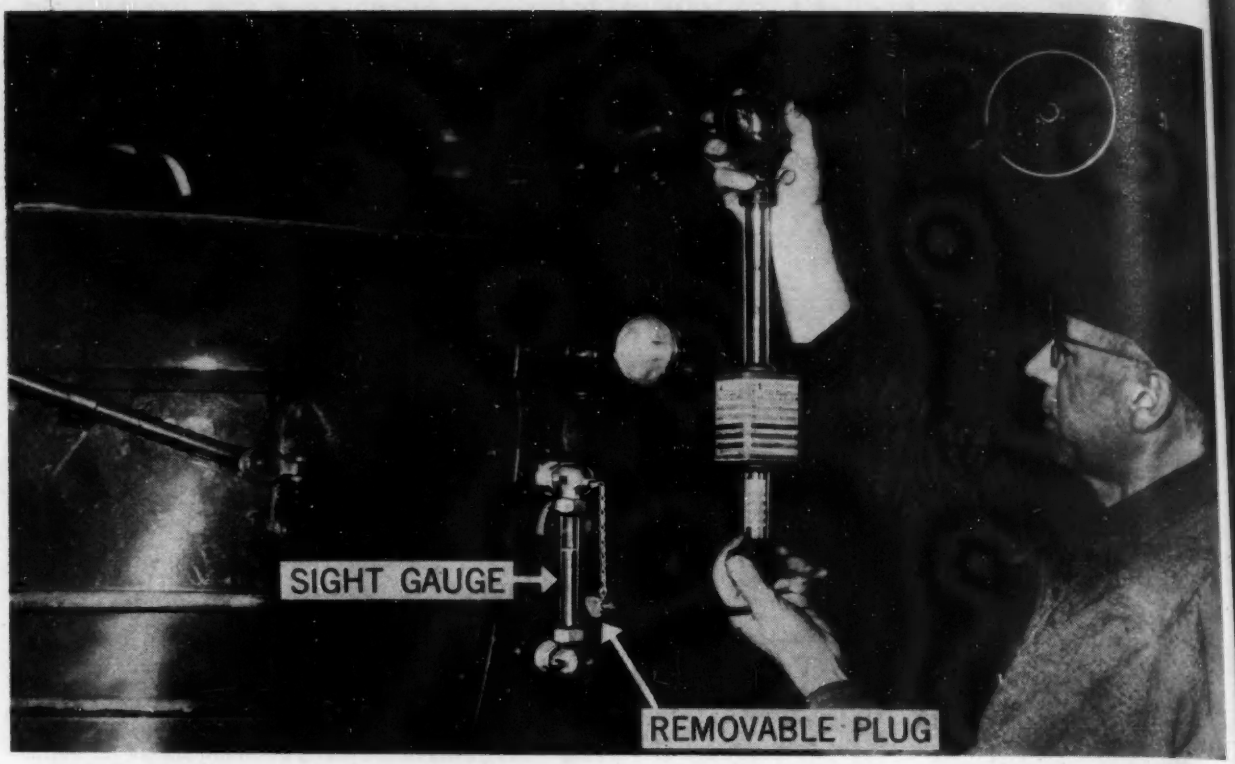
Regular preventive inspection and maintenance service are the only sure means of keeping the cooling system leaktight, clean, and in proper working order, and of maintaining new-car cooling efficiency at all times. Prompt detection and correction of minor irregularities by tightening, adjustments, minor repairs, rustproofing, and cleaning will prevent engine failure and expensive repairs or replacements of scarce parts.

C-1. Radiator and Hot-Water Heater – Radiator-drain-plug leakage should be corrected immediately by tightening or applying nonhardening compound to the threads. Drain cocks that do not close tightly may require replacement.

To prevent breakage of soldered seams and connections, strain and vibration should be avoided in the radiator as far as possible. Radiator anchor bolts should be checked frequently for tightness and any strains on the radiator or connections relieved by suitable adjustment. Where the cab dash is used as the anchor for upper radiator stay rods,



■ Fig. 12 – Sight gage, showing radiator liquid level



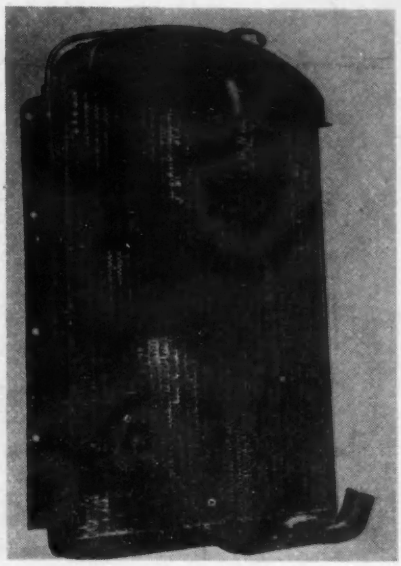
■ Fig. 13 – Testing antifreeze through sight gage opening

the cab-to-frame hold-down bolts must be kept snug to prevent movement and strain of top of radiator. Engine vibration and vehicle movement should not be overlooked as causes of joint failures in the radiator core, tanks, and inlet and outlet fittings. Extreme changes between atmospheric and operating temperatures, especially in winter, set up additional strains that may cause seam breakage. When the seams break, the solder corrodes out; but breakage rather than corrosion is the most general cause of radiator leakage.

Neglect of small seam leaks may result in a complete radiator failure, as well as leakage, overflow loss, rust-clogging, and overheating difficulties. For permanent repairs, soldering by an experienced radiator man is strongly recommended. Stop-leak preparations may seal small leaks, but cannot be depended on for permanent correction of the leakage. Even soldering is not generally practicable for repair of leaks resulting from corrosion perforation of the thin water-tube walls in the core. A stop-leak preparation may seal corrosion leaks temporarily, but usually corroded cores must be replaced. (See Fig. 14.)

At least monthly or at each lubrication period, the appearance of the cooling liquid, as regards color, rust, and so forth, should be checked with the engine at driving temperature and running. More frequent checks can be made without extra work by observing the solution condition in the hydrometer when testing antifreeze. A rusty solution indicates the immediate need of rust-prevention treatment. Heavy rust deposits in the radiator call for prompt cleaning of the cooling system. Cold spots on the radiator core, with the engine hot, indicate clogging.

With radiator-clogging, pump vacuum increases in the bottom tank of the radiator and in the connections to the inlet side of the water pump. To test clogging, limited use is known to have been made of a vacuum gage connected to an open radiator drain cock for checking radiator water-tube restriction. A pressure-vacuum type of gage should be employed, since pressure is developed on the inlet side of the pump under certain conditions. Vacuum



■ Fig. 14 – Seam leakage of radiator core

testing for radiator-clogging would require a previous knowledge of normal vacuum, with the radiator clean, to be dependable.

Another way to test clogging is offered by observation of liquid level rise in radiator top tank. When flow through the radiator core is restricted, accelerating the engine with the vehicle standing will cause the liquid level to rise and possibly overflow. Liquid level rise in some vehicles may be observed through the open filler neck.

The prevention of radiator corrosion damage, and also rust clogging, are discussed in detail in sections E and F.

C-2. Radiator Top Tank Baffles – Sheet-metal baffle plates of various designs are installed in the upper tanks of radiators to distribute more uniformly the flow of liquid through the water tubes and to prevent pumping over and excessive turbulence of the liquid entering the tank, which would cause aeration, air entrainment, foaming, and overflow loss. Occasionally the baffles break loose and interfere with the proper flow of liquid. It is, therefore, important, when making periodic inspections of the radiator, that the condition of the baffles should be examined through the filler opening.

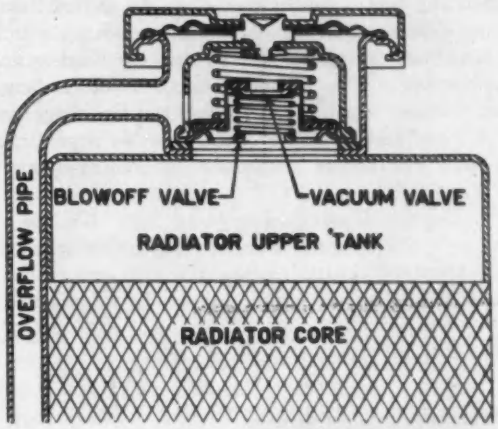
C-3. Radiator Cap – The radiator cap is subjected to high temperatures, which cause relatively rapid deterioration of the gasket. Leakage of the radiator cap may result in cooling liquid being thrown on the engine, which, in the case of alcohol antifreeze, creates a fire hazard, especially with overheating and boiling. Ignition of alcohol vapor under the hood may spread to the lower opening of overflow pipe when the vehicle and engine are stopped. With the vapor burning at the overflow pipe outlet, removal of the radiator cap may result in the flame traveling up through the overflow pipe and causing a burst of flame out of the filler opening.

The underside of the radiator cap is exposed to the extremely corrosive effects of a hot steam and air mixture in the air space of the upper tank during driving. Since the cap is above the normal liquid level, it receives little or no protection from any corrosion inhibitors in the liquid, with the result that bayonet-type radiator caps often fail from corrosion damage.

The radiator cap and joint should be inspected regularly and deteriorated or leaking gaskets and badly corroded caps promptly replaced.

C-4. Radiator Pressure-Control Caps in Sealed Cooling Systems – Many vehicles of recent make have built into the radiator cap a normally closed valve which is designed to permit 3- to 9-psi steam pressure in the system before opening. This pressure raises the boiling point of the cooling liquid and permits somewhat higher engine-operating temperatures without overflow loss from boiling. If the steam pressure becomes great enough to open the valve, the pressure drops and sudden violent boiling may occur with large overflow losses. Steam pressure in a sealed cooling system increases the leakage tendency at hose connections and water joints. To prevent the collapse of hose and other parts which have no internal support, a second valve in the radiator cap of a conventional sealed cooling system opens under vacuum when the system cools.

If a cooling system with the pressure valve radiator cap is overheating, remove the cap slowly and carefully to avoid possible flash of steam and hot cooling liquid that would scald the face and hands as well as spot the vehicle finish. Pressure radiator caps should be inspected frequently for tightness of the gasket joints. To avoid possible damage to the system from either excessive pressure or vacuum, both valves in the cap should have a periodic check of proper opening and closing pressures, and should be serviced or replaced in accordance with the vehicle manufacturer's directions. (See Fig. 15.)



■ Fig. 15 – Radiator pressure-control cap

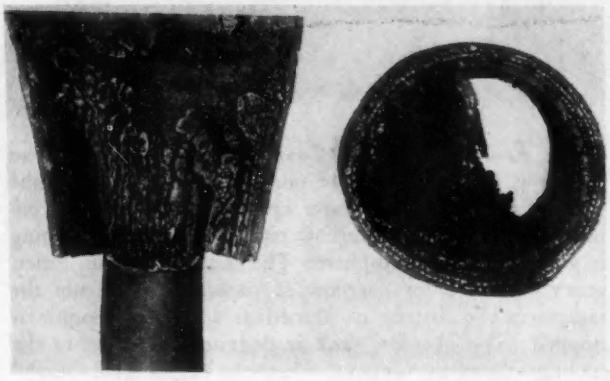
C-5. Radiator Overflow Tank – Usually installed as an accessory, radiator overflow tanks are located under the hood of the vehicle. A lower opening in the tank is connected to the radiator overflow pipe, and an upper opening is vented to the atmosphere. The tank acts as an emergency container for overflow of cooling liquid from the radiator while driving or immediately after the engine is stopped. The overflow tank is designed to return to the cooling system by vacuum, when the engine cools down, any overflow occurring from boiling. Proper functioning of the overflow tank depends on maintaining an airtight cooling system, including tight connections and free, unobstructed flow between the radiator and the tank. If either liquid or air leaks develop in the cooling system and cause failure of the vacuum, any overflow into the tank will not return to the radiator, and liquid will be lost when the tank overfills. When, upon stopping the engine, overflow of cooling liquid from afterboil is large, it may overfill the tank and cause overflow onto the engine, introducing a fire hazard in the case of alcohol antifreeze. The same hazard would exist if a leak developed from corrosion perforation of a steel overflow tank or from breakage of a tank joint.

C-6. Rubber Hose Connections – Hose clamps should be checked, and tightened if necessary, at least every 30 days or 1000 miles, and clamps which buckle the hose or do not make tight joints should be replaced. Engine vibration has a tendency to loosen hose connections. Each time the hose connections are opened for any reason, carefully examine the inside lining. Inspect the inside of heater hose every fall and radiator hose every 10,000 miles and replace if necessary. When installing new hoses, clean the pipe connections and apply a thin layer of nonhardening sealing compound. Do not use grease of any kind on hose. Forcing undersize or swollen hose over the pipe connection may tear the inner liner and cause it to protrude into the coolant stream and restrict circulation. Be sure hoses

are installed without kinks or sharp bends. Reinforcing springs inside radiator hoses should be checked for corrosion. Do not fail to check the condition of underseat heater hoses.

The quality of hose has more to do with its service life than standard cooling liquids. Overage hose failures are due to swelling, hardening, cracking, and rotting. Serious overheating may be caused by old radiator hose collapsing, or shedding rotted rubber that clogs the radiator core and is very difficult to remove. Swelling of hot-water heater hose may cut down the flow so that car heating becomes unsatisfactory. Hose without fabric reinforcement may break without warning and cause sudden, large cooling-liquid losses and serious overheating. No dependence can be placed on outside inspection of cooling-system hose. (See Fig. 16.)

C-7. Engine Water-Jacket Joints and Gaskets – Wide changes in temperature, normally occurring when an engine is warming up and cooling down, especially in winter, impose strains on all gasket joints. In addition, gaskets



■ Fig. 16 – Inside deterioration of water hose

deteriorate with time, and corrosion occasionally develops in metal joints, such as core-hole plugs. Any leakage in water-jacket joints is aggravated by pump pressures which may run as high as 35 psi.

Leaky core-hole plugs should be replaced immediately. Before installing a new plug, clean the core-hole seat and coat it with a suitable sealing compound. Use the recommended tool for driving the new plug in place. Merely tightening the bolts on thin water-jacket cover plates may start leakage, if it does not already exist, by bending the plate under the bolts and breaking the old gasket.

All outside water-jacket-gasket joints should be checked for tightness at least every 30 days or 1000 miles. This also applies to thermostat and pump-housing gaskets. When installing new gaskets, thoroughly clean the metal contact surfaces and apply a suitable sealing compound to the gasket unless otherwise recommended by the vehicle manufacturer.

Drainplug leakage should be corrected immediately by tightening, or applying a nonhardening sealing compound to the threads. Drain cocks which no longer close tightly usually require replacement. (See Fig. 4.)

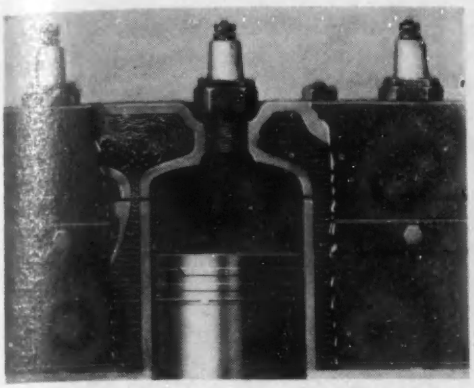
C-8. Cylinder-Head-Gasket Joints – There are actually about 20 individual joints in the water transfer holes between the cylinder head and block of a 6-cyl engine, the looseness of any one of which will allow unobserved leakage of liquid into the cylinder or leakage of exhaust gas into the cooling system. The cylinder-head joint is not only subjected to the strains of normal temperature changes in the engine, but also to explosion pressures as high as 600 psi. Besides the serious injury which may be caused by cooling-liquid leakage into the engine, exhaust gas blown into the cooling system forms acids which cause corrosion damage to cooling-system metals, as well as rapid rust formation and radiator clogging. Considering the seriousness of the trouble or damage that may result from cylinder-head-gasket leakage, more thought should be given to preventive servicing of the cylinder head.

The statement of the old-time mechanic that he can properly tighten a cylinder head with an ordinary wrench by feel has long since been disproved by checking his work with a tension-indicating wrench. Cylinder heads can be tightened too much as well as too little and excessive tension may distort the block casting at valve seats and cylinder bores, permitting piston blowby and valve leakage that seriously affect engine performance and life.

After a cylinder-head joint has once been properly serviced and tightened, the hold-down bolts or nuts should be checked at least every 5000 miles with a tension-indicating wrench. Special attention should be given to tightening bolts or nuts which hold down horns or other accessories subjected to vibration. However, tightening does not always correct leakage already existing and, if there is a suspicion of head-joint leakage, it is safest to replace the gasket after thoroughly cleaning off the joint surfaces and using a gasket compound recommended by the factory. Leaky studs should be removed and the lower threads treated with a suitable sealing compound, while upper stud threads should be lubricated. When the cylinder head is removed for any reason, check the gasket surfaces of the head and block with a straightedge and reface the surfaces if necessary. Never use the old gasket again and always be sure that the new replacement gasket is the correct one and is properly installed. Follow factory instructions on head bolt tension and on the order of tightening bolts. (See Fig. 17.)

C-9. Water Pump and Fan – According to the chemical formula, iron plus water plus air equals rust. When air is drawn into the cooling system through a leak at the pump seal, this air mixed with the cooling liquid may speed up rust formation as much as 30 times and greatly increase corrosion of all metals. Clogging and corrosion go hand-in-hand with chronic water-pump leakage and aeration. Entrainment of air in the cooling liquid also reduces heat transfer and, therefore, may raise engine temperatures and even bring about overheating at high engine speed and output.

If, in the old, adjustable gland-type pump, tightening the packing nut or replacing the packing does not correct the leakage, a worn shaft or bearing may be the real trouble and should be replaced. In the newer packless pumps no adjustments can be made for leakage. This self-adjusting type generally has two seals, a composition or rubber seal on the shaft and a fiber, carbon, or metal thrust seal which bears on either the housing or impeller hub and is held in place by a compression spring. Air suction through a perforated rubber seal can result in serious overflow loss and shortage of liquid in a few miles of high-speed driving. The thrust seal and its seat are



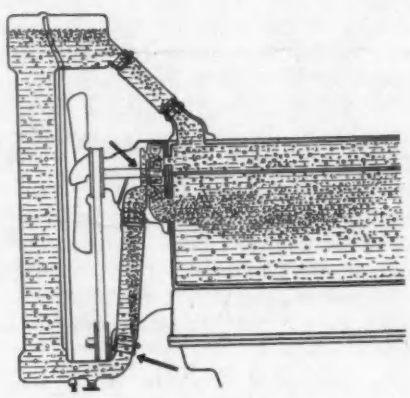
■ Fig. 17 – Exhaust gas leaking into cooling system at cylinder-head joint

subject to wear and leakage. Liquid leakage, if not promptly corrected, will in turn destroy lubrication, resulting in corrosion and wear of shaft and bearings. Thrust seals are prematurely worn by the abrasive action of rust in the cooling liquid and by operation in an overheated engine. (See Fig. 7.)

Pumping failures are generally found to be due to a worn or loose fan belt, pump impeller loose on shaft, edge-wear of impeller blades, or pump housing worn away. A solid freeze-up may cause shearing of the impeller pin. Impeller blades sometimes are worn away by the combined effects of corrosion and erosion in cooling systems when rust prevention has been neglected.

To evaluate the pumping pressure, a rough check for cooling-liquid circulation is made by compressing the upper hose by hand with the engine running at about 1000 rpm at driving temperature, with thermostat wide open. Another indication of pumping action is also obtained under the same conditions by observing the velocity of the liquid entering the top radiator tank, if visible through the filler opening.

For proper lubrication, adjustment, repair, or replacement of fan, fan belt, and water pump, the factory instructions should be followed. This applies particularly to proper assembly of the pump seal parts, which otherwise will allow leakage to continue. Comparatively few water pumps are any longer driven from the generator shaft and many pumps now have self-lubricated sealed ball bearings. (See Fig. 18.)



■ Fig. 18 – Suction of air into cooling system

C-10. Thermostats – Automatic control of engine-operating temperatures is generally accomplished by a thermostatically operated valve in the water line between the water-jacket outlet and the top tank of the radiator, although there is a limited use of thermostatically operated radiator shutters.

For efficient and economical operation and for long life, automatic control of engine operating temperatures is absolutely necessary summer and winter. Minimum thermostatically controlled coolant operating temperatures range from 140 to 180 F, measured at the water-jacket outlet. Maximum coolant temperatures may run considerably higher.

Low operating temperatures during cold weather may result in overcooling of the engine with excessive gasoline consumption, water-oil sludge formation, and wear or corrosion of moving parts. Lubrication failure and serious engine damage will follow clogging of oil screens and lines. Excessively high operating temperatures cause breakdown of the lubricating oil and formation of deposits. Some of the penalties of overheating are sticky valves and piston rings, wear and damage to bearings, pistons, and cylinder walls, cracked cylinder heads or blocks, and even engine seizure.

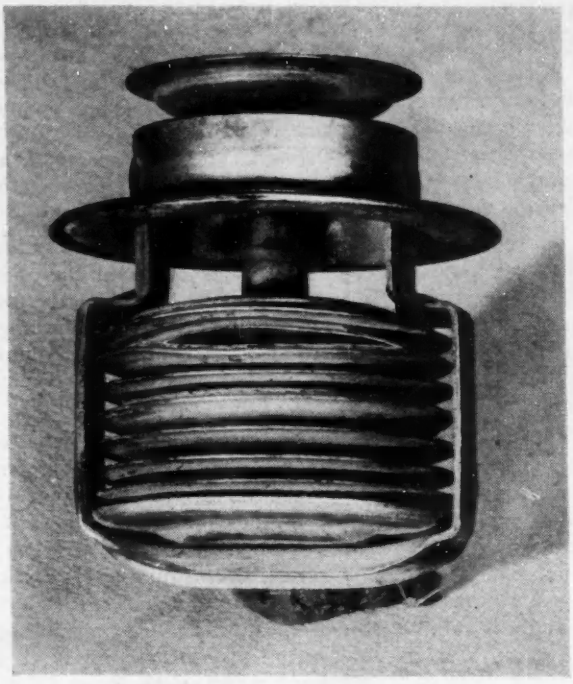
Testing of water-line thermostats should receive more frequent attention in view of serious overcooling and overheating damage that can follow their failure. Vehicles should never be driven with the thermostat out of order or removed. Overheating from any cause may damage the thermostat so that the valve will always stand open, allowing the engine to run too cool; or the valve may not open properly, causing further overheating. The moving parts are subject to wear and rust interferes with operation. The thermostat should always be checked after overheating has been experienced.

High-temperature thermostats with a start-to-open rating of at least 160 F are recommended for improved engine performance and better heat from car heaters during cold-weather driving. The use of two thermostats in the same water line, connected in tandem, introduces an unnecessary complication and should be avoided if possible, as it may cause overheating and overflow loss. High opening thermostats usually eliminate the use of alcohol antifreeze because of its low boiling point. (See Fig. 19.)

C-11. Radiator Covers and Manually Operated Shutters – In certain types of vehicle service, particularly multiple-stop driving, thermostatic control does not always maintain satisfactory operating temperatures during winter weather, with the result that the engine is subjected to the hazards of overcooling previously mentioned.

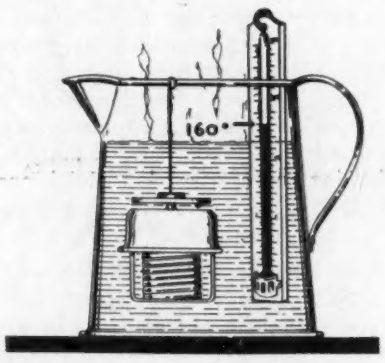
To avoid cold-engine operation under these conditions, manually operated radiator shutters and adjustable radiator covers are commonly employed. When using such radiator covering, the driver must be watchful to adjust them properly for rises in air temperature or overheating will take place.

C-12. Thermostat Testing – Water-line thermostats should be removed and tested at least once a year or every 10,000 miles and whenever the system is opened for inspection or cleaning. A simple shop method for testing thermostat operation follows: Hang the thermostat by its



■ Fig. 19 – Damaged thermostat

frame in water heated 10 to 15 F above the rated start-to-open temperature. If the valve fails to open, the thermostat should be replaced. However, any mechanical irregularities in the operation of the valve due to water flow or pressure must be checked in the car under service conditions. Service tests should also be made on the thermostat unit and mechanical linkage of automatic radiator shutters. (See Fig. 20.)



■ Fig. 20 – Simple shop test for checking thermostat operating unit

C-13. The Effect of Altitude on Thermostat Operating Temperatures – Factors affecting thermostat operation in service are liquid temperature, head, flow and pressure, size of valve vent hole, and balance of the stat. Bellows-type thermostats are also affected by altitude. Still-water tests at reduced air pressures, corresponding to altitudes above sea level, indicate that the opening temperature of the bellows-type thermostat may drop about 2.5 F at 2000 ft elevation, 4.5 F at 3000 ft, and about 9 F at 5000 ft, the elevation of Denver, Colo. The bimetallic spring-type thermostat is not similarly affected because it depends on the expansion of a bimetallic spring to provide the force which opens the valve.

While the bellows-type thermostat may have a tendency to lower cooling liquid operating temperatures slightly at higher altitudes under some driving conditions, it is also true that the boiling point of the liquid drops to about the same extent, so that the margin of safety between the boiling point of the liquid and its operating temperature is maintained. The operation of the bimetal-type thermostat does not compensate for reduced boiling points resulting from higher altitudes, so that any drop in boiling point theoretically should reduce the margin of safety. However, no service data are available to establish whether the effect of altitude on thermostat operation is more than a theoretical consideration.

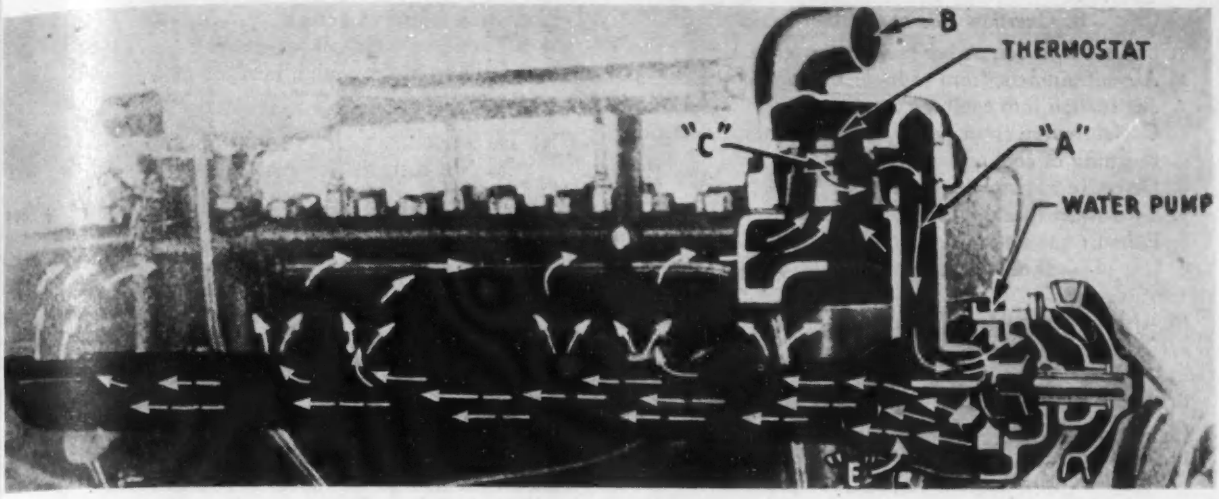
C-14. Water Distribution Tubes – In the more recent models, the engine has a sheet-metal tube located lengthwise in the water jacket for the purpose of obtaining more uniform cooling and to prevent localized hot spots. Through openings in the tube, cool water from the pump is directed towards the exhaust valve seats. In its proper position, this tube receives the full delivery of the pump into the water jacket. When the water-distribution tube is out of position or perforated by corrosion, improper circulation of the cooling liquid will cause local overheating and valve trouble and even heat-cracking of the engine block or head. In overheating cooling systems, where corrosion prevention has been neglected, water-distribution tubes and manifolds have been found perforated by corrosion.

On account of the importance of the water-distribution tube to the proper cooling of the engine, the tube should be inspected at least once a year or every 15,000 miles. This can be done without removing the radiator by taking off the water pump, pulling out the tube part way, and using a flashlight and mirror. If the water tube is removed, a good opportunity is afforded to inspect the inside of the water jacket. As a matter of precaution, water-distribution tubes should be replaced at engine overhaul periods. (See Fig. 21.)

■ D. Diagnosis of Overheating and Overcooling

Frequent check of the heat-indicator gage should be a fixed habit with vehicle drivers. One large fleet operator reports experiments with a thermostatically controlled and electrically operated bell in the driver's compartment as an audible warning of overheating. Any appreciable deviation from the normal heat indication, either high or low, should be reported at the first opportunity, preferably in writing on a "Driver's Daily Report." Following such a warning, there should be no delay in inspection to determine the cause or in necessary servicing to correct it. Constant alertness on the part of the driver with regard to engine-operating temperatures can do much to forestall many serious operating difficulties which are indicated by the first stages of overheating or overcooling of the engine. However, the possibility of a false temperature indication, due to failure of the heat-indication unit or the gage, should not be overlooked.

Overheating can result from any one of a number of conditions or from a combination of several. Often the cause of overheating is not in the cooling system itself. According to the experience of one overland fleet operator,



■ Fig. 21 – Showing coolant flow through distribution tube

improper fuel mixture and valve or ignition timing are the most common causes outside of the cooling system.

The outline which follows is designed as a guide for quick diagnosis of overheating and overcooling, as related to causes both within and outside of the cooling system. (See Figs. 22 and 23.)

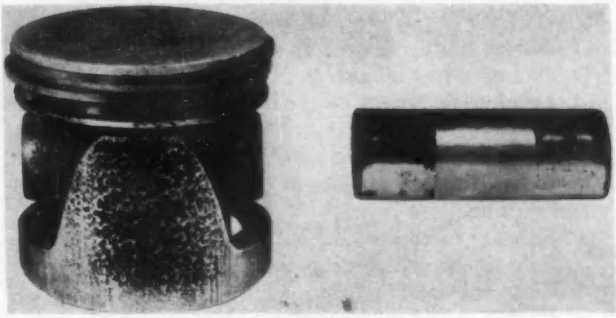
D-1. Diagnosis of Overheating –

I. Low Liquid Level in Cooling System

A. Leakage of system

1. Water hose, radiator, and car heater:
   a. Loose or defective hose clamps and fittings.
   b. Defective rubber hose.
2. Radiator and hot-water heater:
   a. Cracked seams of core, tanks, and overflow pipe.
   b. Broken joints in outlet or inlet fittings.
   c. Tanks or core worn through at points of support.
   d. Corrosion perforation of water tubes.
   e. Loose or defective drain-cock, plug, or vent.
   f. Accidental damage.
3. Engine block water jacket:
   a. Loose or defective drain-cocks or plugs.
   b. Loose or corroded core-hole plugs.
   c. Cover plates loose or gasket defective.
   d. Corrosion-perforation of cover plates.
   e. Water bypass connections loose.
   f. Defective car heater shut-off valve.
   g. Pump housing loose or gasket defective.
   h. Warped block at cylinder-head joint.
   i. Cracked or porous water-jacket casting.
   j. Loose or broken joints in water- cooled oil radiators or lines.
   k. Cylinder-head studs loose in block.
   l. Deteriorated wet cylinder-sleeve seals.
4. Cylinder head:
   a. Defective or blown gasket.
   b. Loose hold-down bolts or nuts.
   c. Cracked, porous, or corroded head casting.
   d. Head casting warped at block joint.
   e. Loose thermostat housing or defective gasket.
   f. Loose heat-indicator fitting.
   g. Loose heater-hose nipple.
   h. Corroded, broken, or loose water manifold.
   i. Loose or corroded core-hole plugs.
5. Water-pump shaft seal:
   a. Worn-out packing, or loose nut, in gland type.
   b. Scored shaft or worn bearing, in gland type.
   c. Scored, worn, or warped thrust seal, in packless type.
   d. Deteriorated or perforated shaft seal, in packless type.
   e. Thrust-seal compression spring failure, in packless type.
   f. Scored or corroded shaft, in packless type.
   g. Worn or corroded bearings, in packless type.

■ Fig. 22 – Damage caused by overheating: left, burnt valves; right, scored piston



■ Fig. 23 – Damage caused by overcooling: left, corroded piston; right, corroded wristpin

B. Overflow loss of cooling liquid

1. Steam formation at hot spots in water jacket.
2. Air entrainment from radiator top tank turbulence.
3. Air suction into cooling system.
4. Coolant surge from pump action and vehicle motion.
5. Foaming of cooling liquid.
6. Defective radiator baffle plate.
7. Two water-line thermostats in tandem.
8. Exhaust gas leakage into cooling system.
9. Use of alcohol antifreeze with high-opening thermostat.
10. Use of alcohol antifreeze for high-altitude driving.
11. Failure of vacuum in system with radiator overflow tank.
12. Corrosion perforation of overflow tank.
13. Loose radiator cap, or cap missing.
14. Pressure valve in radiator cap stuck open.
15. Restricted liquid flow in radiator core.

II. Obstructed or Inadequate Cooling-Liquid Circulation

1. Rust-clogged radiator core.
2. Rust-clogged water-jacket passages.
3. Thermostat valve stuck in closed position.
4. Bypass valve stuck in open position.
5. Collapsed radiator hose, or torn and loose lining.
6. Slush ice freeze-up in radiator core.
7. Water-pump impeller loose on shaft.
8. Pump-impeller blades corroded, worn. or broken; housing interior corroded.
9. Failure or slippage of pump drive.
10. Shortage of liquid from incomplete filling of system.
11. Water-jacket distribution tube corroded through or out of position.
12. Liquid capacity of system reduced by rust deposits.

III. Obstructed or Inadequate Air Circulation

1. Fan belt worn or loose.
2. Fan blades bent.
3. Improper fan equipment.
4. Radiator air baffles out of place.
5. Clogged bug screen.
6. Radiator air passages clogged with dirt, bugs, and so on.
7. Hood louvers defective or closed.
8. License plate or similar obstruction mounted in front of radiator.
9. Manual radiator shutters left closed.
10. Radiator cover not properly adjusted.
11. Automatic shutters not functioning properly.

IV. External Causes Sometimes Confused with Cooling System

1. Engine timing delayed or advanced.
2. Improper fuel mixture.
3. Lubrication system clogged with oil-water sludge in overcooled engine.
4. Lubrication failure from freezing of water in oil screen.
5. Oil breakdown deposits in engine; valves and piston rings sticking.
6. Shortage of engine oil.
7. Exhaust line thermostat out-of-order.
8. Clogged exhaust muffler or line.
9. Engine in bad mechanical condition.
10. Dragging brakes.
11. Excessively high, sustained speed.
12. Overloading of vehicle.
13. Traveling with tail wind under heavy load.
14. Driving in deep sand, mud, or snow.

D-2. Diagnosis of Over-cooling –

1. Thermostat:
   a. Not installed, or removed.
   b. Valve stuck in open position, or fails to close.
   c. Valve-opening temperature too low.
   d. Bypass valve stuck in closed position.
   e. Bypass line clogged or blocked off.
2. Stop-and-go (multiple stop) driving at low engine speed and output.
3. Thermostatic control fails to maintain adequate engine-operating temperature.

(Part II of this report will be published in the February issue of the SAE Journal.)

Test for Ring Sticking

For a number of years, The Pure Oil Mechanical Laboratory has used the quantity of blowby gases as an indication of the ring activity in the testing of heavy-duty motor oils in a single-cylinder diesel test engine. The extent of blowby has been found to be the most reliable indication of ring sticking, although other methods, such as top ring temperature, have been tried.

The usual method of collecting blowby gases by sealing the crankcase and passing all gases in the crankcase through a gas meter is employed. The gases pass from the crankcase to a surge chamber where oil and unburned fuel are removed and the gas temperature is reduced to room temperature. From the surge chamber the gases are passed through a household gas meter and then vented to the atmosphere. The gas meter measures 1 cu ft per revolution of the meter hand.

Blowby measurements are made by an instrument that continuously records the quantity of blowby gases in cubic feet per minute to give a complete record of blowby during a test run. The blowby rate will remain fairly constant throughout the test until ring sticking occurs, at which point the blowby rate will increase sharply.

The blowby recorder consists of a standard household gas meter and a recording unit. The recorder was revamped from a Leeds and Northrup Micromax recorder.

There are times during a test when the blowby rate will rise due to momentary lining up of ring gaps or ring flutter, but the blowby rate will come back to normal very shortly. When ring sticking occurs, the blowby rate will continue to increase over a period of 30 min or more. When this definite trend is noticed the run is shut down and the engine is dismantled for inspection.

Blowby measurements with this instrument have never given a false indication of ring sticking, as subsequent teardown has always substantiated the indication of a stuck ring.

Excerpts from the paper entitled: "An Instrument for Recording Blowby Gases in an Internal-Combustion Engine," by R. R. Proctor, A. J. Stock, and D. J. Wangelin, Mechanical Laboratory, The Pure Oil Co., presented at the SAE National Fuels and Lubricants Meeting, Tulsa, Okla., Nov. 4, 1943.

The Future of Aviation

continued from p. 19

life, being most conscious of aviation and skilled in some particular part and probably consciously or unconsciously desiring to own or operate an airplane of their own. In addition to these we already have well over 1,000,000 men and women in the aviation industry in this country – in the manufacturing plants, servicing organizations, airlines, or schools.

We shall also have in the peace many, many airfields, never before in existence, which have been built to feed this machine of war and then will be available to commerce. If we can have a freedom of the air, this will apply not only to the United States but, thanks to the fine job done by the Air Transport Command, to many important places in the world as well, and our commerce will prosper.

Aviation should then take its proper place in the transportation and private travel picture. I have always deplored the belief that aviation will replace other forms of transport. I do not believe this will be true. Even with these thresholds larger than ever before, I doubt whether aviation will touch nine-tenths of the transportation now carried by rail, road, and water. Aviation will simply supplement and in turn be supplemented by the rest of our vast transportation system.

With the advent of the transcontinental overnight sleeper plane, it became possible for a New Yorker to spend a weekend in Los Angeles, San Francisco, or Seattle and vice versa. Many did. Certainly this travel did not come from any other source because no other source could provide the same service in less than a week. The same will be true when a New Yorker can spend a weekend in London or Moscow.

Each of the prominent airports should become a beehive of industry in itself. All modern airport terminals already have many auxiliary businesses, including newsstands, barber shops, lunchrooms, and in some cases, swimming pools, branch banks, haberdashery stores, jewelry and perfumery counters and certainly each airport of the future should have a large-sized garage and a drive-yourself system.

It is a safe presumption that the development of such a system at our air terminals would meet with instantaneous success. Speed and accessibility are going to be two of the prime factors in the race to recapture markets and outlets which have been lost or made dormant by the war.

So let us step over the thresholds for a minute and look at 1953 with a world at peace and, I hope, an international police force and international freedom of the air, and in these United States some hundred-thousand miles of modern airway – some of it multiple airway; a thousand cities regularly served by air transport; and many thousands of others on mail, express and perhaps passenger pickup, with transport service of 1 hr, every 30 min, by air to Boston; 2 hr, every 30 min, by air to Chicago; 7 hr, every hour, to the Pacific coast; overnight to London; and with a large number of lucky people owning a private plane of either rotating lift or conventional type. Fanciful – yes – but practically I believe it can come true – engineering-wise it is possible. Let us be sure that that thing in human relations which we call politics does not stop it. And if it does come true, I hope I can have a part in bringing it about.

SAE Coming Events

Buffalo – Jan. 12

Hotel Markeen; dinner 6:30 p.m. Reclamation of Rubber – Howard L. Wiley, U. S. Rubber Reclaiming Co. Synthetic Rubber – George L. Miller, Dunlop Tire & Rubber Co.

Canadian – Jan. 19

Royal York Hotel, Toronto, Ont., dinner 7:00 p.m. Subject: Arcticizing. Speaker to be announced.

Cleveland – Jan. 3

Cleveland Club; dinner 6:30 p.m. Post-War Automotive Vehicles. Speakers: D. G. Roos, vice-president in charge of engineering, Willys - Overland, Robert Cass, chief engineer, White Motor Co.

Colorado Group – Jan. 20

Gates Rubber Co., Denver; dinner 7:30 p.m. Synthetic Rubber and Testing of Rubber Materials – K. G. Custer.

Metropolitan – Jan. 6

Pennsylvania Hotel, New York; meeting 8 p.m. Design of Aircraft Accessories from a Maintenance Viewpoint – Major-Gen. Clement McMullen.

Mohawk-Hudson Group – Jan. 4

DeWitt Clinton Hotel, Albany; dinner 6:30 p.m. Post-War Powerplants for Personal Airplanes and Automobiles – Carl T. Doman, vice-president, chief engineer, Aircooled Motors Corp.

Peoria Group – Jan. 3 and Jan. 31

Jan. 3 – Jefferson Hotel, Peoria; dinner 7:30 p.m. – meeting for SAE members only. Stress Analysis of Crankshafts – W. G. Johnson, Caterpillar Tractor Co.; Instrumentation for Stress Analysis Work – J. F. Millam, Caterpillar Tractor Co.; Fuels – J. H. Smith, Caterpillar Tractor Co.

Jan. 31 – Jefferson Hotel, Peoria; dinner 7:30 p.m. The Casting of Aircooled Aluminum Cylinder Heads – M. J. Gregory, foundry manager, Caterpillar Tractor Co.

Pittsburgh – Jan. 25

Mellon Institute, Pittsburgh; dinner 6:15 p.m. Speakers: Park H. Martin, planning engineer, County of Allegheny; E. L. Schmidt, district engineer, State Highway Department, Willard H. Buente, member and chief engineer, City Planning Commission.

St. Louis – Jan. 11

Forest Park Hotel, dinner 6:30 p.m. Speaker and subject to be announced.

Southern California – Jan. 7

Hollywood-Roosevelt Hotel, Los Angeles; dinner 7:00 p.m. Speakers: Jim Goodenough, chief engineer, Diesel Division Adel Precision Products Corp.; Capt. Jordan, U. S. Army Air Forces; R. H. Price, engine representative, Commonwealth Aircraft Corp. of Melbourne, Australia, and Lt. (jg) J. L. Teets, USNR.

Southern Ohio – Jan. 10

Van Cleve Hotel, Dayton; dinner 6.30 p.m. Gliders – for War and Peacetime Use – A. F. Arcier, chief engineer, Waco Aircraft Co. Illustrated with movies.

Syracuse – Feb. 7

Museum of Fine Arts, Syracuse; dinner 8:15 p.m. The Post-War Car – Roy Cole, vice-president in charge of engineering, Studebaker Corp.

About SAE Members . . .

Charles F. Kettering, directing head of General Motors Research Laboratories, is shown receiving the John Fritz Medal for notable scientific and industrial achievement from Harold V. Coes, retiring president of ASME, at the annual meeting of that Society on Dec. 1. Mr. Kettering is a past-president of the SAE

JOHN M. THOME, who is a lieutenant (jg), USNR, may be reached at Navy Yard, Mare Island, Calif. Before entering the service he had been layout draftsman for Superior Engine Division, National Supply Co., Springfield, Ohio.

LT. JOHN IRONSIDE is attached to the Royal Canadian Ordnance Corps of the Canadian Army, overseas. He had formerly been stationed at No. 1 Proving Ground Detachment, Ottawa, Ontario, Canada.

KENNETH F. BROOKS is with the Nineteen Hundred Corp. of St. Joseph, Mich., as a master mechanic. He had been works manager for National Steel Car Corp., Ltd., Malton, Ontario, Canada.

KARL B. SMITH, JR., who had been engine test laboratory engineer, Aircooled Motors Corp., Syracuse, N. Y., is now field service engineer for the Eastern Aircraft Division of General Motors Corp., Linden, N. J.

Caryl C. Lewis has been promoted from plant manager of Schick, Inc., New York City, to vice-president in charge of manufacturing. Mr. Lewis previously supervised layout and complete equipment at Bendix-Westinghouse Automotive Air Brake Co.'s largest factory units

OLIVER W. INSKEEP, formerly a consulting engineer in Detroit, has joined Moore Equipment Co., Stockton, Calif., as chief engineer.

C. J. LIVINGSTONE has entered the U. S. Naval Reserve as a lieutenant commander assigned to the Fuels and Lubricants Division of the Office of the Quartermaster General. He had been chief automotive engineer for Gulf Research & Development Co., Pittsburgh.

LORON G. KURTZ is division engineer for the Bus Maintenance Department of the New York City Transit System, Brooklyn, N. Y. He was formerly director of motor equipment of the Department of Public Works, New York City.

DOUGLAS H. MORETON has left the Research Division of Standard Oil Development Co., Bayway, N. J., where he was aviation fuel research engineer, to become fuels and lubricants consultant for the Quality Division of Douglas Aircraft Co., Santa Monica, Calif.

Formerly in charge of the Fuels and Lubricants Unit of the U. S. Army Ordnance Department, Tank-Automotive Center, Detroit, **FREDERICK E. NEEF, JR.,** is now a captain in the U. S. Army, same department, Camp Seeley, Imperial, Calif.

E. R. REDFORD, formerly production manager for Sterling Engine Co., Buffalo, N. Y., is now connected with Nash-Kelvinator Corp. in Detroit, as staff master mechanic.

ARTHUR C. BATES is now connected with Roller-Smith Co., Bethlehem, Pa. He had been assistant professor in the mechanical engineering department of Lehigh University, same city.

ROBERT ARTHUR HITCH, who had been doing powerplant development work for Glenn L. Martin Co., Baltimore, is now an engineer for General Electric Co., Lynn, Mass.

Walter J. Ewbank

WALTER J. EWBANK has been promoted from manager of research and development to chief engineer of Briggs Clarifier Co., Washington. He also heads a newly created department designed to promote cooperation between sales and engineering departments.

Previously service manager at Burtonwood Repair Depot, Warrington, Lancaster, England, **JOHN W. SUTCLIFFE** is now assistant chief engineer for the Air Transport Auxiliary, Maidenhead, Berks, England.

CONRAD A. TEICHERT has joined Grand Rapids Stamping Division of General Motors Corp., Grand Rapids, Mich., as supervisor of engineering. He had been with Engineering Service, Inc., Detroit, as a mechanical engineer.

HARRY E. OBERST, formerly draftsman and designer for Pesco Products Co., Cleveland, may now be reached at Company D, First Battalion, Third Platoon, Engineers Replacement Training Center, Fort Belvoir, Va.

WALTER E. **STRAESSER,** electrical engineer for Chrysler Corp., has been transferred from the Engineering Division Laboratories at Highland Park, Mich., to the Chrysler Tank Arsenal Proving Grounds, Utica, Mich.

FARLEY E. **BECKETT,** formerly instructor of diesel engines at Frank Wiggins Trade School, Los Angeles, and instructor at the U. S. Navy Diesel School, Terminal Island, Calif., is now an associate mechanical engineer at U. S. Naval Dry Docks, same city.

OLIVER C. **SPURLING** is now associated with the British Ministry of Supply Mission, New York City, as a consulting engineer.

ARTHUR S. **SPARKS,** who had been chief engineer of Thorne Engineering Corp., Burbank, Calif., is now general manager and owner of Muntz-Sparks Tool & Die Mfg., Pasadena, Calif.

Formerly chief engineer, Ruckstell-Burkhardt Mfg. Corp., Elmira, N. Y., **HARRY L. BURKHARDT** is now chief engineer for Andover Motors Co., same city.

R. LYLE **BRACE,** president and chief engineer of Brace Engineering Co., Indianapolis, is now a consultant for the Chemical Resources Section, War Production Board.

S. G. Tilden

S. G. **TILDEN,** former chairman of the Metropolitan Section, whose appointment as a lieutenant commander was announced in a recent issue of the *SAE Journal,* has been assigned to Navy's Office of Procurement and Materiel, Park Square Building, Boston.

CHARLES S. **FISHER,** partner of Saylor-Beall Mfg. Co., Detroit, has recently been made executive vice-president of the company. He still retains his connection with Triangle Engineering Co. in St. Johns, Mich.

CAPT. JOHN ST. **HORNOW** has been transferred from the Ordnance Service Command Shop, Fort Ord, Calif., to the Ordnance Department, Benicia Arsenal, Benicia, Calif.

Previously divisional superintendent for McCord Radiator & Mfg. Co., Detroit, where he was employed for 18 years, **EDWARD P. ODDY** is now sales engineer for J. N. Fauver Co., same city.

E. G. **SANDER,** who had been service representative for Ryan Aeronautical Corp., San Diego, has joined Consolidated Vultee Aircraft Corp., Lindbergh Field, same city, as field service representative.

Niles-Bement-Pond Promotions

Succeeding **CLAYTON R. BURT** as president and general manager of Pratt & Whitney Division of Niles-Bement-Pond Co., West Hartford, Conn., is the former president of Chandler-Evans Corp., **CHARLES W. DEEDS.** Mr. Burt, who has been promoted to chairman of the board, will continue to spend full time at the West Hartford plant which has been under his executive management since 1924, while Mr. Deeds will retain active management of Chandler-Evans, which was recently acquired by Niles-Bement-Pond.

Clayton R. Burt, above, and Charles W. Deeds, left

ARTHUR C. **SNYDER,** previously automotive tester for Universal Oil Products Co., Riverside, Ill., has entered the U. S. Army Air Forces. He may be reached at Headquarters & Headquarters Squadron, Materiel Command, Wright Field, Dayton, Ohio.

ROBERT GRANT has resigned from Young Radiator Co., Racine, Wis., where he was vice-president of manufacturing, to join Modine Mfg. Co., same city, as plant manager of the LaPorte Division.

Previously assistant staff engineer of Caterpillar Tractor Co., Peoria, Ill., **KENNETH M. BROWN** is now an engineer for AiResearch Mfg. Co., Los Angeles.

VERNON L. DURRSTEIN, formerly assistant chief engineer of Buda Co., Harvey, Ill., is now with Harnischfeger Corp., Port Washington, Wis., as chief engineer of the Diesel Engineering Division.

RICHARD F. EMMONS, who is now a cadet in the U. S. Army Air Forces, had been a technical apprentice for White Motor Co., Cleveland, in private life.

FURBER MARSHALL, who had been general manager of Marshall-Eclipse Division, Bendix Aviation Corp., Troy, N. Y., is now connected with Pharis Tire & Rubber Co., Newark, Ohio.

JOHN PAUL BLACK, associated with Standard Motor Co., Ltd., Coventry, England, has recently been knighted. He had served as a captain with the Royal Tank Corps in World War I.

EDWARD C. HOENICKE, assistant to the general manager, Foundry Division, Eaton Mfg. Co., Detroit, has been reappointed chairman of the publicity committee of Gray Iron Founders' Society, Cleveland and Washington.

EINAR T. HANSEN, formerly an instructor of mechanical engineering at the University of Wisconsin, Madison, is now employed by Jacobsen Mfg. Co., Racine, Wis., as a development engineer.

EDWIN A. SMITH, a colonel in the Armored Force, may be reached at A.P.O. 957, c/o Postmaster, San Francisco. He had been stationed at Camp Campbell, Ky.

WILLIAM P. KENNEDY, previously consulting engineer in New York City, is now general manager of the Brodie System, Inc., Brooklyn, N. Y., an engineering emergency repair service, as well as

C. F. B. Roth

Carl T. Doman

Carl T. Doman, formerly vice-president and chief engineer of Aircooled Motors Corp., Syracuse, N. Y., is now first vice-president. C. F. B. Roth, who has been Aircooled Motors' general sales manager for the past five years, has been appointed vice-president in charge of sales

maintenance consultant for B. & J. Auto Spring Co., Inc., same city.

Formerly manager of the Aircraft Division, Canadian Vickers, Ltd., Montreal, Quebec, Canada, **N. F. VANDERLIPP** is now factory manager at Curtiss-Wright Corp., Columbus, Ohio.

E. T. FOOTE, vice-president of Globe-Union, Inc., Milwaukee, Wis., was elected president of the Association of American Battery Manufacturers at its recent annual

E. T. Foote

meeting. Other SAE members who are directors are: **J. A. MINCH,** general manager, American Wire Division of Electric Auto-Lite Co., Port Huron, Mich.; **B. F. MORRIS,** vice-president of Thomas A. Edison, Inc., Kearny, N. J.; and **A. G. PHELPS,** sales and service manager, Delco-Remy Division, General Motors Corp., Anderson, Ind.

SAE student members who have recently entered military service are: **ENSIGN ALLAN L. JONES,** USNR, Naval Training School, Cornell University, Ithaca, N. Y., formerly Ohio State University; **MEYER L. ROTHENBERG,** U. S. Naval Academy, Annapolis, Md., formerly Lawrence Institute of Technology; **PFC. RICHARD A. HENSHAW,** Fort Monmouth, N. J., previously University of California; **ENSIGN WILLIAM B. CRUMP,** A-V (S), USNR, Naval Training Station, University of Minnesota, Minneapolis, formerly Lawrence Institute of Technology; **WILLIAM F. CHASE,** formerly University of Detroit, now at Company B, Barracks 28, Pennsylvania State College, State College, Pa.; **JAMES P. McSWEENEY,** 15th Battery, Second Platoon, Antiaircraft Artillery School, Camp Davis, N. C., formerly University of California; **JOHN F. SMITH,** air cadet at Yale University, New Haven, Conn., formerly University of California; **RAYMOND WILLIAM HASSE, JR.,** U. S. Navy, V-12 Unit, Quarters Six, Chicago, formerly Lawrence Institute of Technology; **JOHN J. KANE,** U. S. Army, Company G, Officer Candidate School, Aberdeen, Md., formerly A. & M. College of Texas; **CHARLES E. KINCAID,** air cadet, Company C, Platoon 7, Drexel Institute of Technology, Philadelphia, formerly General Motors Institute of Technology; **DONALD L. MITCHELL, JR.,** Truax Field, Madison, Wis., formerly Detroit Institute of Technology; **EDWARD L. PFLUG,** Company B, Third Platoon, 87th Infantry Battalion, Camp Roberts, Calif., formerly University of Oklahoma; **JOHN H. E. WEBB,** pilot officer in the RCAF, formerly University of Toronto; **ENSIGN ROBERT J. REEL,** USNR, U. S. Naval Training Station, Great Lakes, Ill., formerly Ohio State University.

Also **DONALD F. GROGAN,** U. S. Naval Training Station, Great Lakes, Ill., formerly University of Detroit; **ROBERT A. MORAN,** Company D, University of Maine, Orono, Me., formerly Lawrence Institute of Technology; **EDWARD E. COCKRELL,** ensign, USNR, c/o Fleet Postmaster, San Francisco, formerly Case School of Applied Science; **DONALD L. SEELIG,** staff sergeant in the U. S. Army Air Forces, Camp Luna, N. M., formerly Oklahoma A. & M. College; **LOUIS F. MORTENSON,** U. S. Naval Air Forces, Stuyvesant Hall, Delaware, Ohio, formerly Wayne University; **T. P. MAYER,** formerly New York University, now aviation cadet in Technical School, Yale University, New Haven, Conn.

ENSIGN WILLIAM W. WATSON, USNR, is a ground school engineering instructor at the Naval Air Training Center, Pensacola, Fla. In civilian life he had been employed at Chevrolet Motor Division, Flint, Mich.

STEVEN B. WILSON has returned to active participation in the Fram Corp., East Providence, R. I., where he is a chairman

Steven B. Wilson

of the board of directors. He had been serving as a lieutenant colonel in the U. S. Army.

ADOLPH PASCHAL BUQUOR has been transferred from the Martin-Parry Corp. in London, England, where he was vice-president, to the York, Pa., branch of the company, where he is chief of ordnance design, development and research. Mr. Buquor is known for his development of the adapter and other mechanical equipment by which field artillery of the U. S. Army has been modernized.

AUSTIN R. TROMBLY, owner of Trombly Truck Equipment Co., Portland, Ore., is a member of the Advisory Committee, Automotive Division, Trailer Section, War Production Board.

ELLIOTT B. HIGGINS, who had been assistant naval architect for Willamette Iron & Steel Corp., Portland, Ore., is now associated with Webster-Brinkley Co., Seattle, Wash., machinery designers and manufacturers.

ALFRED S. ALBINAK has resigned his position as general manager of Engineering Specialties Corp., Detroit, to devote his time to industrial engineering and consulting work.

H. M. TAYLOR, has been appointed manager of the Manufacturers Sales Division of Firestone Tire & Rubber Co. with headquarters in Akron. Mr. Taylor, who

H. M. Taylor

has been with Firestone since 1915, was formerly manager of the Detroit Area Manufacturers Sales organizations of the company.

JOHN DEAN WAUGH, who formerly served with the U. S. Army, First Service Area Air Depot, Eighth Air Force Service Command, Overseas, is now an instructor in aircraft propellers for Lockheed Overseas Corp., Division of Lockheed Aircraft Corp., A.P.O. 636, New York City.

L. M. LONG has joined Battelle Memorial Institute, Columbus, Ohio, as research supervisor. He had been chief metallurgist and foundry superintendent of Bunting Brass & Bronze Co., Toledo.

JAMES C. RIPLE, JR., who had been experimental test engineer for Lycoming Division, Williamsport, Pa., is currently located at the Air Base Hospital, Orlando, Fla.

Awards of the ASME Medal to **LEWIS K. SILLCOX,** New York Air Brake Co., for distinguished service in engineering and science, and the Worcester Reed Warner Medal to **IGOR I. SIKORSKY,** Vought-Sikorsky Aircraft, for outstanding contributions to engineering literature, were made at the 64th ASME Annual Meeting Nov. 29-Dec. 3. SAE members who spoke at various sessions were: **J. G. KREYER,** Firestone Tire & Rubber Co.; **PAUL G. HOFFMAN,** president, Studebaker Corp.; **ALEXANDER KLEMIN,** New York University; **RALPH S. DAMON,** vice president, American Airlines, Inc.; and **EDWARD G. BUDD,** president, Edward G. Budd Mfg. Co. **RUDOLPH F. GAGG** was installed as vice-president of the Society. He was formerly chairman of the SAE Metropolitan Section, and has presented numerous technical papers at SAE and other engineering societies. Mr. Gagg is assistant to the general manager, Wright Aeronautical Corp.

JOHN R. BOND, who had been design engineer for Aerojet Engineering Corp., Pasadena, Calif., is now with AiResearch Mfg. Co., Los Angeles, in the same capacity.

F. T. [illegible]OULD is no longer with Guiberson Diesel Engine Co., Dallas, as assistant to the president in charge of Washington office. He is now with Breeze Corporations, Inc., of Newark, as Washington representative.

HARRY A. **HUEBOTTER** is a major in the U. S. Army Air Forces. He had formerly been secretary and treasurer of Officers' Mess, U. S. Army Air Forces, Basic Training Center 8, Fresno, Calif.

PAUL H. WINTER, formerly service sales engineer for E. R. Merrill Spring Co., New York City, is now with Rogers Diesel & Aircraft Corp., same city, as production manager.

ALEX TAUB, chief engineer of the Foreign Economic Administration, Washington, writes that **FEA** recently has had a number of calls from people who seem to think that organization is developing a "mysterious global small car." He says, "We are not working on any such program. Although we handle a variety of engineering . . . we do not do any designing whatsoever. For every foreign government interested in a good piece of engineering, we have always advised that they use private sources for their work, and we will furnish what guidance we can."

R. C. HOFFMAN, who had been design engineer with Packard Motor Car Co., Detroit, is now a director of the Detroit Research Laboratory of Borg-Warner Corp. He was a member of the "Car of the Future" symposium of Metropolitan Section Oct. 7.

EUGENE C. KAEUPER, formerly junior layout draftsman with Allison Division, Indianapolis, has entered the U. S. Army. He is connected with Headquarters & Headquarters Squadron, Materiel Command, Section B, Wright Field, Dayton, Ohio.

EDWIN O. CASENHISER, chief inspector of Murray Corp. of America, Detroit, has been transferred from the A-20-B Division to P-47 Division.

WILLIAM M. SIESEL, previously general manager, Lenoxite Division, Lenox, Inc., Trenton, N. J., is now a consulting engineer for Flight Training Research Association, Inc., same city.

K. L. R. SWARTZELL, formerly fleet service manager of what was once the Shanghai Power Co., was one of the 1494 exchanged internees who returned on the S. S. Gripsholm and docked Dec. 1 in New York after a 64-day trip. Leaving Yokohama on Sept. 16 aboard the S. S. Teia Maru, formerly a French liner with a prewar passenger capacity of 450, the first leg of the journey was completed on Oct. 15 when the port of Mormugao, in Portuguese India south of Bombay, was reached. Three days later the Gripsholm arrived there with 1330 Japanese civilians. The transshipment was made and the Gripsholm left for New York on Oct. 22. In the interest of protecting Americans still in Japanese prison camps, Mr. Swartzell, who lived in Japan since 1928, refused to discuss details of his incarceration.

Whitley B. Moore

Previously general manager of sales of Timken Steel and Tube Division, **WHITLEY B. MOORE** is now director of sales for all divisions of Timken Roller Bearing Co., Canton, Ohio.

LT.-COM. A. E. SHEPARD, A-V (S), USNR, may now be reached at the Aviation Supply Office, Naval Aviation Supply Depot, Philadelphia. He had formerly been engineering overhaul officer, Assembly & Repair Depot, U. S. Naval Air Station, Norfolk, Va.

SAE members who have recently received changes in company status are: **HUGH POPE,** National Malleable & Steel Castings Co., Cicero, Ill., from assistant sales manager to manager of malleable iron sales; **A. J. ST. GEORGE,** War Department, Chicago Ordnance District, from associate engineer to industrial production engineer; **F. HERBERT SHARP,** Consolidated Vultee Aircraft Corp., San Diego, Calif., from group engineer to assistant project engineer; **ROBERT WILLIAM SCOTT,** Wright Aeronautical Corp., Paterson, N. J., from senior test engineer to assistant project engineer; **C. W. SHAW,** Wilcox-Rich Division, Eaton Mfg. Co., Detroit, formerly in charge of laboratory, now executive engineer; **ROGER W. KAHLENBERG,** Kahlenberg Bros. Co., Two Rivers, Wis., from secretary and mechanical engineer to vice-president and chief engineer; **A. MARQUIS LOSEY,** Ranger Aircraft Engines, Farmingdale, L. I., N. Y., from checker to designer; **CECIL EARL SIMMONS,** General Motors Corp. of Canada, Ltd., Oshawa, Ontario, Canada, from junior layout draftsman to engineer in charge of dynamometer; **M. D. MURRAY,** Wright Aeronautical Corp., formerly service engineer at Service Division, A.P.O. 3372, New York City, now a technical representative, A.P.O. 528, c/o Postmaster, New York City; **K. D. SMITH,** B. F. Goodrich Co., from assistant vice-president at Akron, Ohio, to manager of National Sales & Service Division in Washington; **DOUGLAS B. NICKERSON,** Lockheed Aircraft Corp., Burbank, Calif., from layout draftsman to junior design engineer; **JOSEPH F. FLAHERTY,** Johnson Bronze Co., Detroit, from sales representative to vice-president; **ERNEST GRANT WHIT-**

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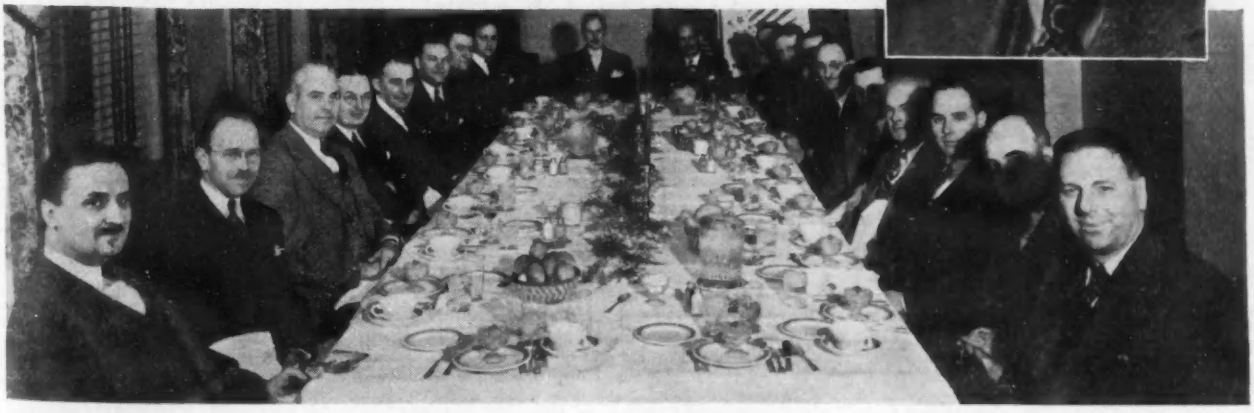
Celebrating at a party given to Robert Cass in Syracuse were, left to right: J. J. Punke, E. Phillip Crowell, R. J. Purcell, C. W. Simmons, Arthur Volles, W. B. Smithers, Lt.-Com. Paul Griffin, N. S. Focht, Mr. Cass, C. B. Spase, Major H. S. Ford, Jr., Forrest E. McGuire, George W. Seiler, E. R. Fish, Jesse Sero, Richard Whitney, Dr. Charles Lawrence, Carl Doman and J. D. Williams. Inset: Charles B. Spase, chief engineer, Lipe-Rollway Corp., is the newly-elected chairman of the Syracuse Section



News..

..OF THE SOCIETY

SAE Ignition Research Paves Way For Better Aircraft Engine Output

by A. L. BEALL
Chairman
SAE Ignition Research Committee

SAE Ignition Research Committee Members

A. L. Beall, Chairman, Wright Aeronautical Corp.
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Ernest K. Von Mertens, Pratt & Whitney Aircraft

PARALLELING aircraft engine development in a period of time which has seen an increase of over 1/3 hp per cu in. of displacement, ignition development has shown substantial improvement in spark plugs, cable, and magnetos.

Magneto development has been along the lines of increased voltage for equal current output. Cable development has provided better resistance to moisture and temperature ranges with improved resistance to the higher voltages required. Spark plug development has provided improved resistance to fouling and longer electrode life with improved resistance to the higher operating temperatures and pressures resulting from higher specific engine output.

In any stage of the development where the operation became marginal for the power requirement of the engine, the spark plug became the first target of abuse, as the usual result of increased severity of operating conditions is to reduce the time within which a given type of spark plug will provide acceptable performance.

Developments in spark plugs, magnetos, and cable have now progressed to the point where the performance of any of the separate components is outstandingly good, and deficiencies are found in their relations with each other rather than in the individual components.

It is not uncommon for cable to withstand 50 kv, for spark plugs to function 150 hr without change, and magnetos to require only lubrication for many hundreds of hours.

Studies Relationships

The relation of each of the separate components of the ignition system with each other is now a major problem to be solved in the development of a wholly satisfactory ignition system. For instance, ignition cable rarely fails throughout its length even under laboratory test conditions of exaggeratedly high voltage. Put one end of the same cable in a spark plug terminal well and apply an identical voltage, and the time within which flashover occurs is greatly reduced. The flashover invariably occurs near the end of the cable in the spark plug well and frequently is actually independent of the cable itself. This is demonstrated by carefully removing the cable from the spark plug well, cleaning or replacing the latter and re-establishing the original conditions of the test with the same cable installed. Test of the cable may then be continued for many hours without failure.

Bench tests applied to the spark plug alone for long periods of time at high voltage do not eventually result in flashover. In spark plug terminal wells in service, moisture, chemical and electrochemical action resulting from heat and corona and the effects of oxidation in the presence of any entrapped air all tend to produce reaction compounds conducive to flashover from the

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spark plug terminal button to the adjacent shielding gland.

Expressed another way, each component is capable of satisfactory performance under any of the conditions of temperature and electric load imposed upon it, but assembled together as a unit the useful life with acceptable performance is shorter than might be expected from the tests of each component.

The SAE Ignition Research Committee in the several laboratories of its members is intensively studying the problem of extending the operating time within which these units assembled as an ignition system provide acceptable performance. Modifications of the spark plug terminal assembly and different means of employing the standard units of cable, harness, and spark plug to inhibit progressive deterioration and resultant impaired performance or durability have first place in these studies.

The problem is not one of measured deficiencies in either the cable, spark plug, the terminal, or any other component, but rather the effect of assembling them together on the engine. The technicians of the companies making each type of component are pooling their knowledge, experience, test data, and ideas for improvement without reservations. Some of the developments are already on test and give promise of the substantially increased trouble-free operation of the critical parts of the high tension ignition system.

Post-war application of these developments indicates a reasonable possibility of an ignition system requiring attention and preventive maintenance, beyond lubrication, only at the time of engine overhaul.

Progress Reported on Aluminum Alloy Forging Stock Inspection Method

by M. E. BOYD, Chairman,
SAE-W.E.B. Subcommittee,
Inspection of Aluminum Alloy Forging Stock

SO rapid was the growth of the aluminum forging industry to meet the huge demand, that there are no generally recognized specifications for aluminum alloy forging stock. Before the demands of war, only a few shops had become experienced in forging practice, and information is scarce.

The SAE War Engineering Board became interested in the problem in connection with other phases of war production, and among the subcommittees appointed was one to report on "The Inspection of Raw Material for Aluminum Alloy Forgings." Inspection of this material is concerned primarily with:

1. Surface defects;
2. Internal defects;
3. Chemistry, and
4. Physical properties after heat treatment.

Seams produced during fabrication are the most serious surface defects. Nicks, gouges, and other abrasions are usually

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WAR ENGINEERING BOARD Develops Data in Scientific Approach to Universal Problem of TORQUING OF NUTS

ENDEAVOR of the SAE War Engineering Board to work out an age-old engineering enigma – determining how much a bolt, stud, or nut should be tightened – has produced a progress report outlining technical aspects, giving some of the answers, promising additional data, and putting the responsibility definitely upon the man with the wrench.

The project has both immediate and long-term objectives – solving a problem currently spotlighted by mass-production of aircraft engines in converted shops, and, by coordinating and reporting facts, to provide recommendations for guidance of industry in assembling both aircraft and motor vehicle engines.

Pending further tests and studies, initial findings of the W.E.B. Committee on Torquing of Nuts in Aircraft Engines permit of such conclusions as:

- Nut tightness should be measured by the only reliable method – actual stretch of the bolt.
- Tension in the bolt, when measured by bolt stretch, should be 80% of the yield strength either of bolt or abutment, whichever is weaker.
- Other than bolt extension, no accurate method of determining nut tightness has been found; variations run as high as six to one even with torque wrenches.
- Data at hand recommend the torque wrench over the angular turn method of tightness measurement, although improvements subsequently may make the angular turn more accurate.
- Present assembly methods causing no service troubles should not be changed to meet these recommendations.
- Short studs should be avoided; any method of increasing the elasticity of the bolt, or of decreasing that of bolted members, is desirable.
- Nuts always should be turned in a tightening direction to the next position in aligning slots with cotter pin holes.
- Minimum thickness of plating should be used on threads or other contacting surfaces.
- Further tests are necessary (1) to minimize the variability of friction and of bolt tension inaccuracy resulting from using torque wrenches, and (2) to develop the possibility of designing for bolted assemblies a spring member which would, by amount of deflection, accurately indicate bolt tension.

Discussing the overall problem, the progress report states that the fatigue strength of highly-loaded bolts and studs finally is determined by the man with the wrench. Good design and materials, heat treatments, and superior manufacturing processes are desirable, but the relative responsibility is estimated as being in the proportion of 16 for the man with the wrench to one for designer, for metallurgist, and for processing.

Series of fatigue tests, made under direction of the committee, are reported as revealing that when a nut is tightened against reasonably rigid abutments to produce in the bolt a tension equal to or greater than the working tension load, practically no stress change takes place and the bolt's operating strength approaches its static strength. Fatigue test findings disclose that astounding increases in fatigue durability can be produced merely by initial tightening. With an increase in initial bolt tension to 7220 lb from 1420 lb, fatigue durability rises to 214,500 stress cycles from 5960. When initial tightness reaches the neighborhood of 8000 lb, fatigue durability rises to about 4,500,000 stress cycles, tends to increase, and thereafter roughly parallels maximum bolt load.

Design of, and materials used in, a bolted assembly have a pronounced effect upon bolt strength. Gasket areas should be large in the vicinity of the bolt, relatively smaller in proportion to the distance from the bolt. A spring washer clamped between the bolt head or nut and the bolted assembly should be dimensioned to support either the required external load or the initial bolt tension, whichever is greater. Any expedient which increases the rigidity of the bolted assembly, or the elasticity of the bolt, increases the bolt's fatigue strength.

Despite this increase, severe service is likely to produce failures unless initial ten-

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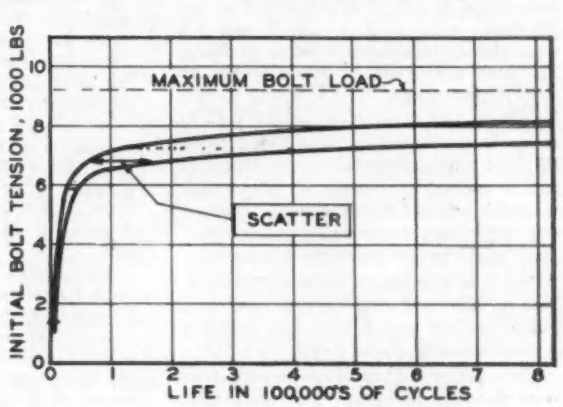

Life of a bolt is tremendously lengthened merely by increasing initial tightness

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IX. Bearings | **X. General**

L. A. Lanning | N. L. Deuble

Chairman Frank P. Gilligan and Vice-Chairman W. P. Eddy announce the appointment of the Iron & Steel Division Panel Chairmen, as shown herewith, and acceptance of representation by the Navy Bureau of Ships by Com. W. C. Latrobe and Lt.-Col. J. H. Frye, representing the Army Ordnance Department. Panel vice-chairmen are L. I. Ferrall, Panel I; Victor C. Crosby, Panel II; B. Clements, Panel III; H. Bornstein, Panel IV; R. B. Schenck, Panel V; H. B. Knowlton, Panel VI; R. W. Roush, Panel VII; W. L. Roy Steele, Panel VIII, and E. S. Rowland, Panel IX

Army

Lt.-Col. J. H. Frye

COMPLETION of the membership on the ten panels of the reorganized SAE Iron & Steel Division, and outlining the program for the expanded program of the group, took place at the executive committee meeting Dec. 7 in Detroit.

Desirability will be investigated of again making available in the SAE Handbook some characteristic physical property curves, including tensile strengths, elongation, yield points, and reduction of areas. The Division will also determine whether such curves would be more serviceable as line or bands.

A review of the present standard method for determining hardenability (SAE 1943 Handbook, p. 314) will be made, with particular reference to test bars and charts.

Final revisions are being made on the steel hardness conversion numbers, as adopted by the SAE and ASTM. The new standard will contain tabulations of Vickers, Brinell carbide ball, Rockwell C and B, and the Shore scleroscope numbers, and will show the approximate equivalent strengths. The new tables will be extended beyond their present ranges.

Current SAE steel compositions will be shown in the SAE 1944 Handbook. Some NE steel compositions have been eliminated and several added because of substitutions on one hand, and the availability of others and wider use of certain low-alloy emergency steels on the other hand.

Provision is made to include representatives of hot- and cold-working steel converters, such as tubing mills and specialists in manufacturing special forms.

When completed, the Division will have more than 100 members. The reorganization was first announced in the *SAE Journal*, December, 1943, p. 26.

Nonmetallic Division Formed By SAE Standards Committee

SAE standards work on all the nonmetallic materials used in the automotive industry has been brought together under the newly formed Nonmetallic Materials Division of the SAE Standards Committee.

The new Division will take over the many projects that have already been carried to various stages of completion by other divisions, such as the felt standards, which had been developed under the SAE Parts and Fittings Division; the determination of classification and test requirements for rubber compounds, which were being developed under the Passenger-Car Division; and specifications for upholstery leather, which also were developed under the Passenger-Car Division. In addition, it is expected that the Division will formulate and develop many new projects of its own, as the need for them arises.

As part of its work, the Division will pass upon recommendations submitted to the SAE by other groups working on specifications of nonmetallic materials, such as the SAE-ASTM Technical Committee A on Automotive Rubber and the Felt Association.

Two reports from the SAE-ASTM Technical Committee A are already before the Division for approval. One of these consists of extensive revisions of the Classifications and Test Requirements for Rubber Compounds to bring the specifications shown on p. 374 of the 1943 SAE Handbook up to date, and the other is a proposed SAE Standard on Coolant System Hoses (*SAE Journal*, October, 1943, p. 24).

W. M. Phillips, Research Laboratories Division, General Motors Corp., is chairman of the division and W. J. McCortney, Chrysler Corp., is vice-chairman. Other members are: R. R. Abbott, White Motor Co.; R. L. Barton, Mack Mfg. Co.; F. H. Bromm, American Telephone & Telegraph Co.; J. J. Crookston, Autocar Co.; W. P. Eddy, Jr., GMC Truck & Coach Division, General Motors Corp.; J. M. Gauss, Studebaker Corp.; P. W. House, Delco-Remy Division, General Motors Corp.; J. P. Wilson, Ford Motor Co.; H. W. Mohr, Packard Motor Car Co.; H. A. Polderman, Caterpillar Tractor Co.; C. R. Reller, Minneapolis Moline Power Implement Co.; H. M. Schudt, Allis-Chalmers Mfg. Co.; R. B. Gray, Glenn L. Martin Co.; Comm. W. C. Latrobe, Navy Department, Bureau of Ships; and Gerald Reinsmith, Materials Section, Service Branch, Technical Division, Office of Chief of Ordnance.

Journal Index Available

A complete Index covering the twelve 1943 issues (Vol. 51) of the *SAE Journal* is now available to members and subscribers free upon request.

SECTION ROUND-UP

Canadian . . . Past-Chairman James C. Armer highlighted Nov. 17 meeting with report on war and peacetime production of Canadian automotive parts industry . . . Survey of 31 companies showed dollar value production increased from $32 million in 1939 to over $152 million in 1942-aggregate increase of almost 500% . . . while wages and salaries paid raised from $8½ million to $31 million . . . thus, despite increasing wage rates, production in relation to payroll increased.

Cleveland . . . Replacing K. D. Scott, Jr., General Electric Co., as Placement Committee chairman is S. F. Stewart of Leece-Neville . . . Enthusiastic turnout at Nov. 10 national meeting with dinner attendance of nearly 400.

Metropolitan . . . Galaxy of outstanding engineers on hand to discuss paper by Bruce K. Brown, PAW, and Dan P. Barnard, Standard Oil Co. (Ind.) Dec. 2 included: Charles A. Chayne, Buick's chief engineer; Shell's Vice-President J. F. M. Taylor; Max M. Roensch, Chrysler's engine development chief, and R. P. Russell, executive vice-president of Standard Oil Development Co. . . . Audience of more than 400 greeted President-Elect William S. James, who was introduced by Chairman George Freyermuth . . . Groups held forth in discussion beyond 11:30.

Milwaukee . . . Predicting aluminum will become as cheap as iron, and will be used as much, P. B. Jackson foresaw possibilities at Nov. 5 meeting of the metal in industry after the war in view of its present large output . . . Characteristics indicated include light weight, corrosion resistance, non-magnetic, easy fabrication and good machinability . . . Secondary aluminum will be used extensively for cylinder heads.

New England . . . Description of how American boys stayed "in there" plastering the Japs in air-sea battles under guidance of experienced hands illustrated by sound film "Death of the Hornet," shown by Lt. Walter Jennings, USNR, Nov. 16 . . . Depicted story of aircraft carrier, which became Shangri-La from which Jimmy Doolittle headed squadron that bombed Japan, from its launching to final abandonment by crew when put out of action, and when finally shelled and sunk by our warships . . . Fleet operator's only hope is preventive maintenance, whereby competent men keep rapidly wearing equipment rolling, warning of American Brakeblok Engineer E. N. Hatch at same meeting . . . List of do's and don't's for reliable, uninterrupted service from motor vehicles included training mechanics to find and repair defects when small, *not* waiting for breakdown, sure sign of neglect . . . Similar theme stressed at ST. LOUIS SECTION Nov. 9 meeting, where C. A. Reichert mentioned rapid depletion of stock pile of cars and trucks . . . Though problem of replacement and interchangeability of parts being tackled by ODT, antifreeze situation still critical, with no new radiators on market.

Philadelphia . . . Commending contribution of SAE's War Engineering Board to cold starting tests conducted at Camp Shilo last winter, R. L. Weider told story of U. S. Army's work in testing equipment designed to facilitate operation of motor vehicles under subzero weather conditions at Nov. 10 session . . . Classified starting aids into three general types: (a) standby heat, (b) director instant heat and (c) dilution with priming . . . 35-minute movie recorded following phases of work . . . how snow blowers cleared trails, reconnaissance cars of special design and ordinary cargo trucks battled their way through fog . . . what it means to dress for a temperature of —40 F . . . proof testing of every type of equipment which Army would be expected to use in cold climates from personal apparel to armor plate . . . Adolph Gelpke presided for the evening.

St. Louis . . . Pinch-hitting Nov. 9 for Chairman Frederick H. Roever, who was at Chicago Air Cargo Meeting was Vice-Chairman George C. Davies . . . For second successive month top honors to Section in membership campaign . . . Received 260% of assigned quota of applications.

Southern California . . . Emphasizing air power as the key to victory, Mrs. Carol Flanagan, only woman member of Douglas Aircraft Co.'s speaker's bureau, stressed dramatic aspects of aerial warfare on Nov. 12 . . . declared side which has most formidable aircraft resources is side which will win the war . . . Human interest items culled from recent battles personalized her topic . . . Foster M. Gruber presented with gavel honoring his past-chairmanship of Section . . . One-fourth of 125 who came to dinner at meeting were women.

Southern New England . . . Safety rather than style should be main objective in designing post-war car . . . advice of Prof. Dean A. Fales, M.I.T. at Dec. 1 meeting, who says importance of vision in driving has been overlooked . . . Suggests adjustable bucket for sitting comfort . . . He sees car of future with pressure ventilation, curved windshields, hydraulic systems taken from airplane engine, automatic transmissions, plastics and light alloys, if costs of these items are reduced.

Southern Ohio . . . Transportation meeting sponsored by Cincinnati group Nov. 19 featured papers on truck tires and gasoline, past, present and future.

Syracuse . . . "Dad, can I have your helicopter tonight?" may become a standard question in 1950, according to Robert Cass in his forecast on post-war transportation on Nov. 22 . . . Some of his predictions were . . . double-decker railroad coaches running 150 mph . . . improved diesel engines that will do away with locomotive changes at divisional points . . . automobile engines half their present size . . . military trucks will not be used for peacetime service, he said.

Mohawk-Hudson . . . High altitude flying is one of a number of ways in which modern aviation warfare is being conducted, though proponents of all kinds of aviation warfare are now being given opportunities long sought . . . group told Oct. 26 by Sanford A. Moss, who detailed uphill climb of aviation's recognition and acceptance as major weapon of war . . . U. S. planes not only can maintain full sea level power but can also out-perform any of the enemy's altitudes from 30 to 35,000 ft. . . . Inspection trip Dec. 7 took members through brake lining plant and spark plug pilot plant of Bendix Aviation Corp.

Peoria . . . Joint meeting held with ASME Central Illinois Section Nov. 24 . . . capacity audience of 150 attended.

Muskegon . . . Calling the General Motors diesel engine a "power package" because its high degree of interchangeability allows for its use in all types of applications, Rex L. Allbright cited advantages of two-cycle high output diesel engines which have solved innumerable lubrication problems, at Nov. 18 meeting.

Oregon State . . . Attendance of 150 at Nov. 12 meeting representation of civilian students, AST men, SAE members. Army officers and faculty members.

Discuss Aircraft Filter Problems

A MEETING of the Aircraft Carburetor Air Filter Committee, E-17, of the SAE Aircraft Engine Subdivision, was held on Dec. 15 in Detroit. Problems of increasing filter efficiencies without decreasing engine output were discussed by the engineering representatives of filter manufacturers, carburetor engineers, and members of the committee which is headed by Wayne Cannon, Wright Aeronautical Corp. Committee members are:

H. G. Braendel, Continental Motors Corp.; R. N. DuBois, Packard Motor Car Co.; A. S. Horwath, Pratt & Whitney Aircraft; William S. James, Studebaker Corp.; D. E. Moore, Ranger Aircraft Engines, and Clyde R. Paton, Allison Division, General Motors Corp.

Spline Gaging Draft Has Been Prepared

BASED upon AS84A as to tooth form and tolerances, a tentative draft has been prepared by Committee E-7 on involute spline gages.

AS84A, a revision recently issued of AS84, now includes ranges of diametral pitches from 6/12 to 48/96. Members of the committee, one of the working groups of the SAE Engine Subdivision, are:

Gustaf Carvelli, Wright Aeronautical Corp., chairman; G. H. Sanborn, Fellows Gear Shaper Co.; J. L. Goldthwaite, Allison Division, General Motors Corp.; G. L. McCain, Chrysler Corp.; R. J. Osplack, Vinco Corp., and J. G. Perrin, Pratt & Whitney Aircraft.

Seventy-three Companies and Four Government Agencies Furnish SAE Aeronautical Committee Personnel

Among the manufacturing companies represented on SAE Aeronautical Standards Projects, with the number of engineers from each company indicated, are:

AIRPLANE MANUFACTURERS:

Bell Aircraft Co. (2),
Boeing Airplane Co. (1),
Consolidated Vultee Aircraft Corp. (4),
Curtiss Airplane Division (3),
Douglas Aircraft Co. (6),
Fleetwings, Inc. (1),
Grumman Aircraft Engrg. Corp. (1),
Hughes Aircraft Co. (1),
Lockheed Aircraft Corp. (5),
Glenn L. Martin Co. (5),
North American Aviation (2),
Republic Aviation Corp. (3),
Vought-Sikorsky Aircraft (2).

AIRPLANE ENGINE MANUFACTURERS:

Aircooled Motors Corp. (2),
Allison Division, General Motors Corp. (13),
Chrysler Corp. (1),
Continental Motors Corp. (4),
Ford Motor Co. (1),
Jacobs Aircraft Engine Co. (3),
Lycoming Division, Aviation Corp. (10),
Packard Motor Car Co. (4),
Pratt & Whitney Aircraft (15),
Ranger Aircraft Engines (6),
Studebaker Corp., (1),
Warner Aircraft Corp. (1),
Wright Aeronautical Corp. (16).

AIRCRAFT PROPELLER MANUFACTURERS:

Aeroproducts Division, General Motors Corp. (6),
American Propeller Co. (1),
Curtiss-Wright Corp., Propeller Division (6),
Engrg. & Research Corp. (4),
Hamilton Standard Propellers (5),
Sensenich Bros. (1).

AIRCRAFT ACCESSORY MANUFACTURERS:

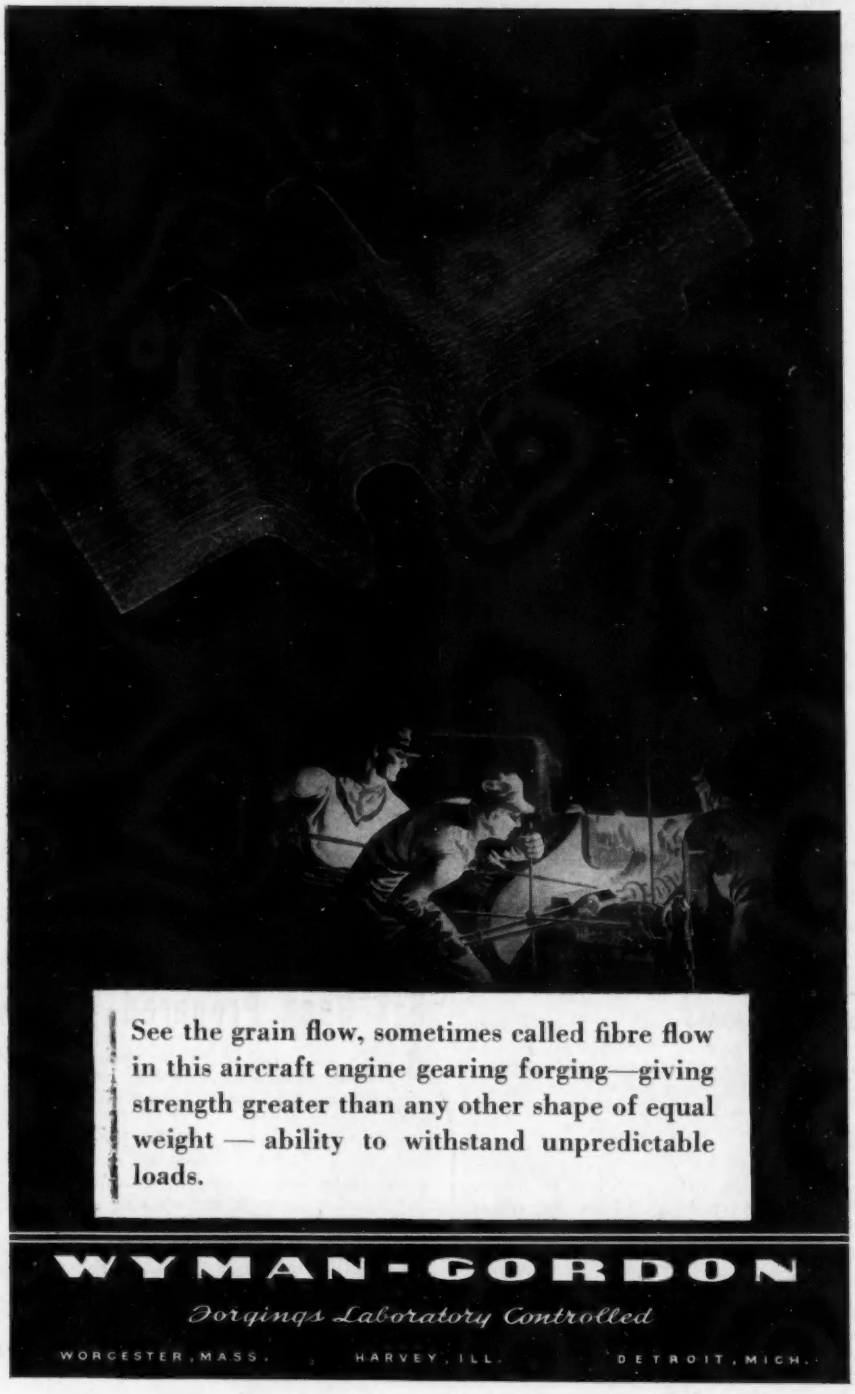
Adel Precision Products (1),
Aeroquip Corp. (1),
Aircraft Accessories Corp. (2),
AiRsearch Mfg. Co. (1),
Aluminum Co. of America (2),
Bendix Aviation, Ltd. (1),
Bendix Products Division (2),
Bendix Stromberg Division (1),
Breeze Corporations, Inc. (1),
Chandler Evans Corp. (2),
Cleveland Pneumatic Tool Co. (1),
Davison Chemical Corp. (1),
Eclipse Aviation Division (4),
Eclipse Pioneer Division (6),
Fellows Gear Shaper Co. (1),
Firestone Aircraft Co. (1),
General Electric Co. (2),
B. F. Goodrich Co. (2),
Goodyear Tire & Rubber Co. (1),
Harrison Radiator Division, General Motors Corp. (1),
Hayes Industries, Inc. (1),
Holley Carburetor Co. (1),
Kollsman Instrument Division (2),
Lewis Engineering Co. (1),
Menasco Mfg. Co. (1),
Manhattan Rubber Mfg. Div., Raybestos-Manhattan Inc., (1),
Northrop Aircraft, Inc. (1),
Parker Appliance Co. (3),
Pump Engrg. Service Corp. (Pesco) (2),
RCA Mfg. Co., Inc. (1),
Simmonds Aerocessories (1),
A. O. Smith Corp. (2),
Henry Souther Engrg. Co. (1),
Sperry Gyroscope Co. (3),
Thompson Products, Inc. (2),
United Aircraft Products Corp. (2),
Vinco Corp. (1),
Weatherhead Co. (1),
Westinghouse Electric & Mfg. Co. (1),
N. A. Woodworth Co. (1),
Young Radiator Co. (1).

AIRLINE OPERATORS:

All-American Aviation, Inc. (1),
American Airlines, Inc. (4),
Northwest Airlines, Inc. (2),
United Air Lines Transport Corp. (2).

U. S. GOVERNMENT AGENCIES:

Bureau of Aeronautics, USN Department (1),
Civil Aeronautics Administration (3),
Materiel Center, U. S. Army Air Forces (2),
Naval Aircraft Factory (1),
Navy Dept., Bureau of Aeronautics (1),


See the grain flow, sometimes called fibre flow in this aircraft engine gearing forging—giving strength greater than any other shape of equal weight — ability to withstand unpredictable loads.
WYMAN-GORDON
Forgings Laboratory Controlled
WORCESTER, MASS.
HARVEY, ILL.
DETROIT, MICH.

W.E.B. Report On Nut Torquing

continued from p. 45

sion equal to the external tension load is maintained. Short bolts and studs, because of their lesser elastic yield, are higher in mortality. Major hazards are listed as loss of thickness in surfaces which embed, displacement of soft plated coatings, plastic compression of gaskets, and materials yielding at high temperatures.

Discussion further indicates it is better to stress a bolt above the yield point of the material than to risk undertightness. Yield is regarded as harmless providing, as is usually the case with bolts and studs having body diameter equal to or less than the thread root diameter, the plastic deformation is insufficient to reduce the bolt's static strength.

Bending loads are reduced as the nut tightness increases. Bending stress ranges are influenced by designing bolted assemblies so as to throw the bending stress change out of phase with the tension stress change. The effect is that of elastically bending the bolt in a direction opposite to the bending induced by external load.

In preparing the progress report, data were obtained on standard sheets compiled from results of comprehensive tests made by Chevrolet and Buick Motor Divisions, General Motors Corp.; General Motors Research; Chrysler Aircraft; Ford Motor Co.; and Pratt & Whitney Aircraft.

W.E.B. member sponsor of the project is E. H. Smith, of Packard Motor Car Co. J. O. Almen, of General Motors Research Division, is chairman of the committee. The members are:

Gustaf Carvelli, Wright Aeronautical Corp.; H. W. Epler, Lycoming Division, The Aviation Corp.; Dem Gerdan, Allison Division, General Motors Corp.; W. H. Graves, Packard Motor Car Co.; E. H. Kelley, Chevrolet Motor Division, General Motors Corp.; G. L. McCain, Chrysler Corp.; P. E. McGrath, Buick Motor Division, General Motors Corp.; M. B. Morgan, The Timken-Detroit Axle Co.; P. W. Schipper, Pratt & Whitney Aircraft; A. D. Whitmer, Studebaker Corp.; and F. C. Young, Ford Motor Co.

Engineers, who are faced with torquing problems in their war work may obtain copies of the progress report from SAE headquarters.

SAE-W.E.B. Reports On U-Joint Lubrication

NEED for simplification on the types of lubricants used by the Army posed an engineering problem in connection with lubricating propeller shaft universal joints of military vehicles.

The Ordnance Department's Tank-Automotive Center requested the SAE-War Engineering Board to study and report on the use of grease for these units, instead of the usually-recommended SAE-140 gear oil in summer and the SAE-90 during winter months.

The special Universal Joint Committee, headed by L. A. Chaminade and under the sponsorship of SAE-W.E.B. Member J. M. Crawford, and including a membership of 18 engineers from truck, car, universal joint, and lubrication system manufacturers, have submitted to the War Department its Progress Report No. 1.

Pointing out that the joints are not manufactured with view of grease lubrication, the report warns that its recommendations should be adopted purely as a war-time emergency measure.

Among the recommendations made were: More frequent lubrication in the field, particularly after the vehicle has been driven through water, mud, or slush;

Current grease gun adapters, such as those specified by the Army, were held to be unsatisfactory. A hydraulic adapter is being developed, it was pointed out, but the committee's consensus was that power grease guns should never be used on any universal joint.

In view of the time required for development, test, and tooling for a new universal joint designed for grease lubrication, the group awaits further requests on this point from the Army.

Facts about

ANTI-FRICTION BEARINGS

Anybody who reads this handy little volume will have a clearer understanding of what bearings do, how they function, all their different types, and how they are applied.

It is "MUST" reading for those who have anything to do with selecting, using or servicing bearings. No "selling" in it—just 32 pages of simple common sense, with more than a hundred helpful diagrams, phantom drawings and photographs. Handy pocket size.

A copy will be sent you on request.

AHLBERG BEARING COMPANY

Manufacturers of CJB Master Ball Bearings

3069 W. 47th St., Chicago, Ill.

AL. FORGING ALLOY Inspection Report

continued from p. 45

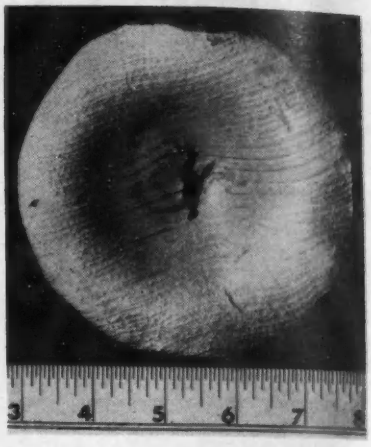
caused by rough handling in the shop and during shipping. Depending upon the end product, these may or may not be serious.

Pipes, inclusions, porosity, rolling cracks and ingot defects are the chief causes of internal defects. These usually occur in large diameter stock, and are much more difficult to detect than surface defects. Cutting the stock often fails to show up these defects, due to the layer of distorted metal resulting from shearing, sawing, or abrasive cutting.

Fortunately the forging operation causes internal defects to show up, often with fractures resembling split wood. Thus the defective material shows itself up before it can get into the end product.

Surface seams present a far more serious and difficult problem for the inspector, because visual inspection rarely reveals the depth of the seam. These usually appear as a dark line running longitudinally the length of the entire bar.

Fortunately, surface seams are more prevalent in stock of two inches and less in diameter. Stock of this size is usually cut into forging slugs by shearing – which usually causes the seam to show up and indicates the extent of repair required to save the piece.



Piping in aluminum alloy forging stock, about 6 in. diameter. Ends have collapsed and ruptured upon being drawn out by hammer

Serving with Chairman Boyd, Willys-Overland Motors, Inc., on the Inspection of Aluminum Alloy Subcommittee of the SAE War Engineering Board are: R. E. Duff, Ford Motor Co.; Harvey Curtiss, Chrysler Corp.; C. L. Foreman, Buick Motors Division; H. F. Walker, Chevrolet Motor Division, General Motors Corp., and Dr. P. V. Faragher, Aluminum Co. of America

Aero Engine Fan Committee Formed

STANDARDIZATION of aircraft-engine cooling fans, their drives, diffusers and other accessories is the assignment made by the SAE Aircraft Engine Subdivision to the newly-organized Committee E-18. This group was formed at the specific request of the Engine Technical Committee and the Airframes Technical Committee of the Aeronautical Chamber of Commerce of America to study the possibilities of standardizing on both propeller- and engine-driven engine cooling fans.

The problem has been aggravated by the trend toward submerged engine design of aircraft, and the introduction of auxiliary powerplants which must be cooled.

Members of the Engine Cooling Fan

turn to p. 60

Oil-Change Practice

continued from p. 23

Look at the score and see what different classes of equipment are doing and see why crankcase draining periods become "plus or minus."

Equipment	Miles or Hr. Crankcase Drained	Average Recommended Practice
Passenger cars	500 to 3000 miles	1000 miles
Trucks	500 to 5000 miles	2000 miles
Buses	1000 to 10,000 miles	3000 miles
Aircraft engines	40 to 150 hr	100 hr
Railroad streamliner diesel	10,000 to 150,000 miles	30,000 miles
Powerplant diesel –		
Hi-speed	50 to 300 hr	100 hr
Lo-speed	1000 to 5000 hr	———

When the score of any set of operations is analyzed, the successful lubrication or drainage period is found to vary "plus or minus" with the locality, with the seasons or months of the year, with the make of the equipment, and with different operators using the same equipment. One thing still holds with crankcase drained oils – clean used oil means a dirty engine, whereas dirty used oil means a clean engine.

When the 36-hr Chevrolet Engine Test Program was being worked out to evaluate the oxidation resistance of heavy duty crankcase oils, a group of oil and engine technicians were operating a Chevrolet engine under laboratory controlled conditions second to none. Yet the Committee said:

"It will be noted that data reported from different laboratories on Oil 15 range from good to bad (90 to 48 engine deposit rating), depending upon some *reason* which is not understood. To clear up this difficulty a *new* lot of oil, known as 15A, is being tested in 10 laboratories."

The *reason* has now been worked out, and the 36-hr Chevrolet Engine Test Program, to evaluate crankcase lubricating oils for bearing corrosion and oxidation characteristics, is an ASTM method of test.

It is the *reason* that makes "plus or minus" scores even when experts are dealing with one make of engine, with the same operation procedure, same drain period, and same oil. There are 57 reasons that affect crankcase draining periods, one of which is oil.

Post-War Car

continued from p. 22

do not permit the substitution of aluminum. There is roughly a maximum of 30% of a car's weight that can be considered as replaceable by aluminum units, and many of these are eliminated by cost considerations. I think there are some places where its use may grow, such as for doors, seat frames, cylinder heads, and other points not highly stressed.

Plastics – Plastics are undoubtedly coming, particularly for decorative treatments, hardware, surface covering, and certain types of treated paper upholstery material. Bodies of plastic plywood or molded plastic with fillers of wood or cloth are far off because of cost.

Other developments – I think there will be interesting developments in the transmission system. In the modern remote-control synchromesh gear box we have a simple solution of the transmission problem. At the other extreme we have the Hydra-Matic transmission—a "tour de force" of engineering – it does everything. We are going to see a lot of development to find a compromise between these two extremes, seeking a performance as near as possible to the full automatic action of the Hydra-Matic drive with the cost as near the synchro box as possible. Some of these efforts will be very good and real progress will result.

Suspension will improve and some engineers will have the courage to employ the continental development of the swinging type of independent rear-axle suspension.

The fluid flywheel alone as now used is a very poor solution of the transmission problem. It doesn't lock up, it doesn't disengage, it slips all the time to some extent, and it cuts seriously into fuel economy.

Rear engine – Our investigation of many layouts shows that any rear-engine job of given displacement and comfort dimensions

ELIMINATE STUD TROUBLE

AMERICAN NATIONAL DARDELET THREADS

The American National Dardelet stud can be produced with minimum tool and gage alteration and incorporates the following advantages:

★ Eliminates lateral motion which results in fretting in service.

★ Overcomes galling during stud assembly.

★ Reduces the necessity of selective fits.

★ Seals against leakage through the thread fastening.

★ Greatly increases resistance to fatigue.

★ Increases strength in tension and torsion.

★ Is economical in production—Inspection simplified.

★ Can be driven into an A.N. tapped hole after reaming.

★ Design features have proven ideal for rolling.

•

A.N. FORM + DARDELET = A.N.D.

DARDELET THREADLOCK CORPORATION

2832 E. Grand Boulevard, Detroit 11, Michigan.

requires a longer wheelbase than the front-engine layout with the same displacement and dimensions. The engine will go to the rear when it becomes clear that unquestionable benefits will be realized in this location without offsetting disadvantages.

Post-War Fuels

continued from p. 23

rods, and crankshafts;

Carburetors and manifolds must deliver more accurately measured charges to each cylinder under all operating conditions;

Pistons and rings will unquestionably follow diesel practice;

Sparkplugs will have to run hot enough at road loads to remain clean;

Crankshaft problems will be even greater than crankcase troubles. We will have to learn more about permitting them to flex and do it quietly without harming the other parts of the engine, and

Transmissions must be improved if we are to achieve operating economy.

There is too little factual information on these problems today to design a successful high-octane automobile engine, but we will do our best to be ready when high octane fuels are available in the filling stations.

Thermostat Designers and Manufacturers Since Automotive Engineers Began Specifying Motor Temperature Control

★ ★ ★

THE DOLE VALVE COMPANY

1901-41 Carroll Avenue, Chicago 12, Illinois

Los Angeles • Detroit • Philadelphia

Improved Gasolines Will Be Ready For Better Engines

by R. P. RUSSELL, Standard Oil Development Co.

(Excerpts from paper entitled "When Better Engines are Built the Necessary Fuel Will be Available," read by Dr. W. J. Sweeney for Mr. Russell.)

FROM an oil man's point of view, it is fortunate that the best aviation engines and the best automobile engines do not require the same types of fuels. Aircraft engines require a fuel of high content *per pound* and high anti-knock value, and the unsupercharged car engines require a fuel of high heat content *per gallon*, with high anti-knock value.

We should be able to unscramble the petroleum products and change the ratios of production and economically produce aviation fuel superior in all around quality required by the future aircraft engines which may be produced in the next few years.

This could be made from iso-paraffinic materials such as alkylates, hydrocodimers, isopentane, and isohexanes.

Sees More Mileage

By operating catalytic cracking, hydroforming, and thermal units to best advantage, gasoline high in aromatics napthenes, and olefins could be produced which would give better mileage per gallon, and have the desirable high Research Octane Number even if the ASTM Motor Method rating was more than 10 points lower.

Alkylation should not be regarded as a "vapor pressure control procedure," because all processes that change the boiling range of petroleum could be similarly considered. Alkylation is, as the authors pointed out, "the backbone of present 100 octane aviation gasoline."

However, hydrocodimers were manufactured in the early 1930's which permitted the commercial manufacture of 100 octane fuel soon enough to enable the design and manufacture of engines for this fuel to be used in the war.

Bottleneck Eliminated

The contributions of catalytic cracking, and fluid catalysts particularly, resulted in a balance between isobutane and butylenes which were vitally needed for the alkylate plants. This rounded out production with a minimum of bottlenecks.

The PAW did an excellent job in taking raw materials from companies without facilities for using them, and in shipping them to other companies with proper equipment.

A good share of the credit for "practically saving the day for our Air Forces" should go to those numerous companies which, before the war, developed processes which have made this ever increasing flood of 100 octane aviation gasoline possible today.

APPLICATIONS Received

The applications for membership received between Nov. 10, 1943, and Dec. 10, 1943, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Buffalo Section: Lawrence N. McKenna, Jackson E. Wood.

Canadian Section: Ronald Grundy Hillier, John N. Nickell, Harley I. Rosser.

Chicago Section: Philip Albanese, Fred J. Avery, Norman Eric Bateson, E. C. Boortz, Emanuel V. Lansky, Charles S. Longstreet, George Henry Miller, John Taylor Newmark, Michael Joseph Reardon, Jr., Frank Sailer, Harold Eugene Wharton.

Cleveland Section: Wayne S. Aldrich, Albert Victor Andrews, James L. Caputo, Vollmer W. Fries, Rex D. McDill, Steve R. Muza, Robert Donald Oldfield, Harry B. Shaper, Wilbert Steffy, F. T. Turner, Charles D. Uldricks.

Colorado Group: Richard S. Arnold, Robert W. Porter, T. M. Sanders.

Detroit Section: William T. Bean, James H. Booth, Fred A. Buchda, John William Carson, Alex Conner, Jr., Joseph H. Coombes, Bly A. Corning, Alex Csizmansky, Joseph L. Cummings, Roman Basil Cuzack, Charles L. Donlon, Walter R. Eames, II, Ray H. Farmer, Victor Albert Ford, Major Richard A. Fox, Frank John Gardiner, Arleigh J. Hess, Carl N. Hanke, George A. Hirshman, George E. Holton, Jack L. Hooven, Nelson J. Kreider, Joseph Mack II, Dwight C. Maier, Aaron L. Mercer, Jr., Clarence W. Myers, John Najjar, William R. Patterson, John V. Prestini, William Leon Pringle, Irving L. Ross, John Ross, Roy W. Roush, John L. Palmer, Frank B. Shissler, Charles K. Taylor, Arthur P. Woods.

Indiana Section: Melvin Dressen, Miss Roberta Harper, Monroe J. Hosford, Ceburn Parker.

Kansas City Section: Gaylord M. Gurtz, Sebastian A. Huebner, Robert J. Schroers.

Metropolitan Section: William Brown Alexander 5th, Earl W. Allington, Donald V. Barker, Robert Arnold Brayman, James E. Cambria, Lieut. Fred E. Cochran, Delbert G. Faust, Kenneth L. Fitts, Irving Forsten, Jack F. Greathouse, Norman F. Joy, Francis J. Kirchman, Mathias Klein, Eugene M. Lang, Melvin D. Miller, Robert D. Noyes, Paul W. Ratcliff, Clarke Alden Rodman, John Sasso, Abram August Shampanier, Gilbert Shaw, William M. Simpson, I. C. Sleight, Ford M. Smith, Martin Stark, Joseph Thomas Sullivan, George E. Ternent, Samuel H. Townsend, Harry R. Weber, Louis F. Werner, Arthur W. Yoder.

Milwaukee Section: Earl William Becker, Emmons Leo Farrell, Merrill A. Scheil.

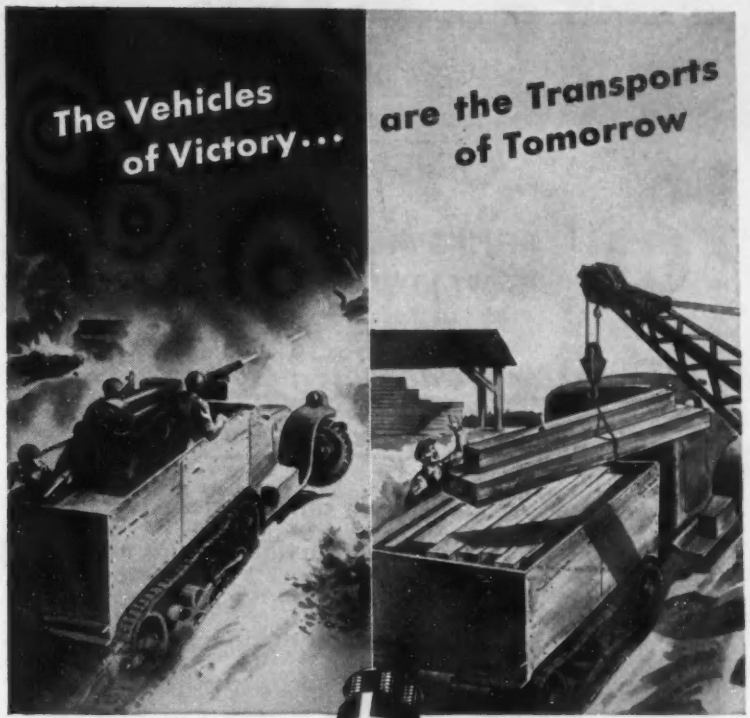
Mohawk-Hudson Group: Thomas Francis Brothers, Charles Z. Smith, Sr.

Muskegon Club: Albert G. Ambs, Somers E. Blackman, Carl E. Burke, Kenneth M. Cloud, Julius Fairfield, Jacob Feenstra, Peter M. Hansen, Henry G. Kaye, Albert J. Lundwall, Carlton E. Messner, Michael Palmer, Herbert I. Steinman, Marion Cole Travis, Gerald D. Whiting.

New England Section: Edward Feldman, James Goldstein.

Northern California Section: Carroll I. Henwood, Jr., Hubert LeRoy Long, Edwin Edward Richter, Jr.

turn to p. 55



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ECLIPSE MACHINE DIVISION

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Nov. 10, 1943, and Dec. 10, 1943.
The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: William E. Barnett (A), James D. Robinson, Jr. (j).

Buffalo Section: Clifford Cook Furnas (M), Victor Newton (J).

Canadian Section: Ellis Stephen Byers (A), Lorne Cavell Elder (J), Russel Lang Gibson (A), Jos. O. Goodman (A), William D. Howe (A), Arthur C. Pullen (A), Arthur J. Sales (A).

Chicago Section: H. Wade Barth (M), Thomas Richard Blakeslee (J), William E. Boris, Jr. (J), Thomas Edward Boyd (A), John C. Buckwalter (M), R. E. McGee (M), Carl G. Nesholm (A), Edward Frederic Obert (M), Philip Alden Sidell (M).

Cleveland Section: W. F. Aylard (M), Christie Batlas (J), John H. Collins, Jr. (S M), Dean Driscoll (J), Kenneth S. Kleinknecht (J), J. H. McDuffee, Jr. (A), Max Don Peters (J), C. O. Slemmons (M), George Thoma (A), Ralph C. Thompson (M).

Colorado Group: Stanley R. Shatto (M).

Detroit Section: LeRoy W. Dahlberg (A), Richard A. Hameister (J), Gilbert F. Hauke (A), Richard B. Hooper (M), Kenneth H. Jacobs (J), Vincent Thomas Kepler (J), Harry Pelphrey (M), Thomas Norman Leofrio Pughe (F M), Ulysses L. Thomas (M).

Indiana Section: James Richard Reed (J), Ernest L. Russell (M).

Metropolitan Section: James D. Abeles (A), Percy H. Ballantine (J), Kenneth W. Barkman (S M), Harold M. Burdick (J), William G. Dallas (J), Robert R. Dexter (M), Winthrop A. Johns (J), Jules P. Kovacs (M), Charles Moyses (A), Lucien Francis Pichenot (M), Lt. Col. Wm. L. Purcell (S M), William Fox Scarberry (J), Will Clifton Sievert (A), S. Bruce Somervell (A), George Stern (A), Martin J. Stoltz (A), Philip F. Weber (M).

Milwaukee Section: William J. Harley (M), Arthur John Kauper (M), George M. Walraven (M).

New England Section: Guy P. Jackson (M).

Northern California Section: Frank R. Hines (A), Lt. Col. Willis S. Wells (S M), Capt. William H. Wickes (J).

Northwest Section: Arthur M. Rhodes (A).

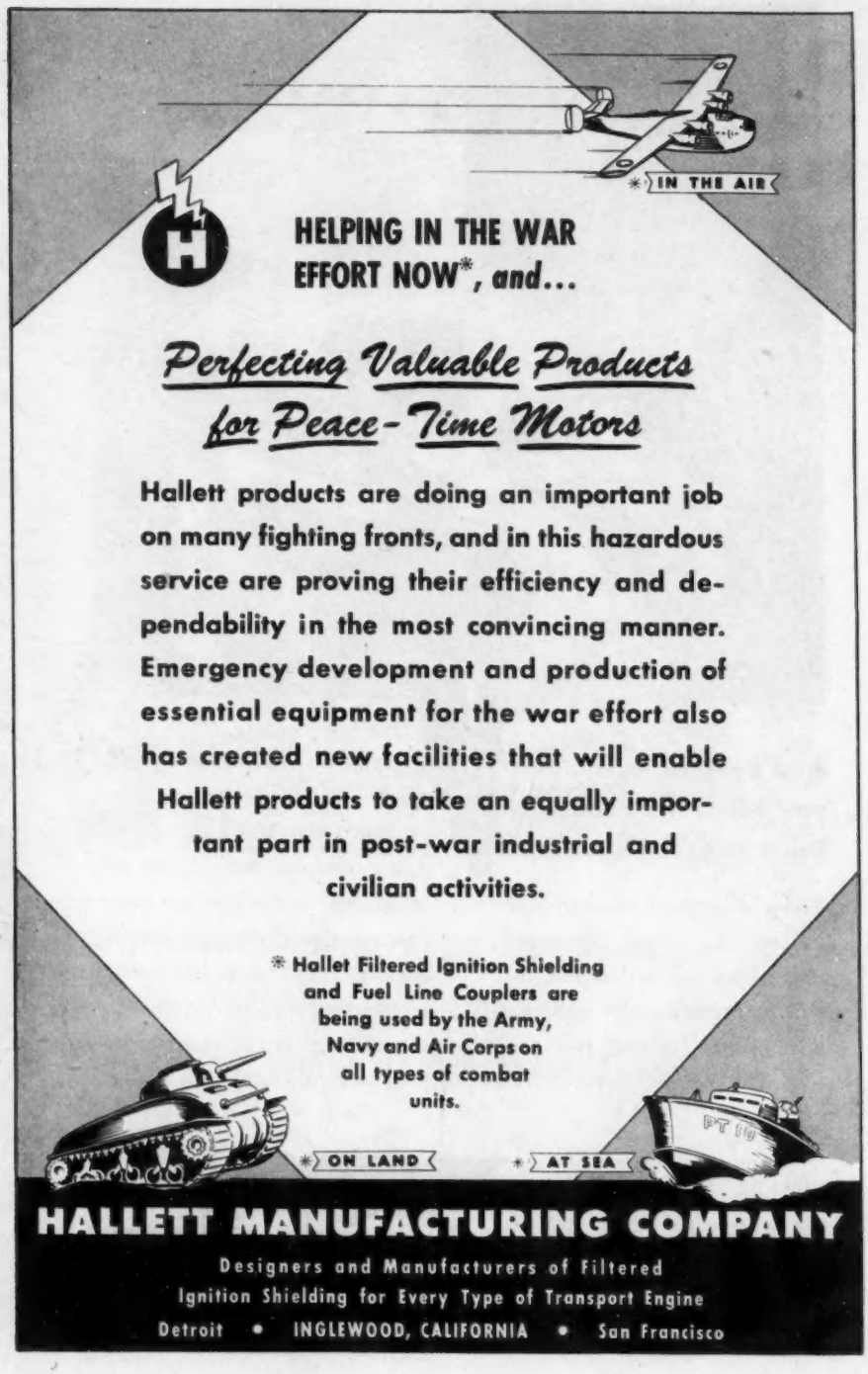
Peoria Group: Eugene R. Alford (J), Richard S. Frank (M), Mitchell McMurray (J), Raymond L. Mussatto (J).

St. Louis Section: T. Joseph Flamm (M).

Southern California Section: Ben Taylor Anderson (M), Dean B. Baumunk (J), George Vincent Carey (A), Lewis W. Cate (M), Alvin N. Cover (J), Lawrence A. Harvey (A), Arthur H. Kannady (A), John MacGregor Logan (J), R. T. Nelson (M), Jerry Rons (A), Charles Lewis Tanner (A), Mitchell M. Thorngate (J), William E. William (A).

Southern New England Section: Joe O. Dean (M).

Washington Section: Ensign John Loman Hacker (J), Lt. (jg) James Hough Henry (J), Herbert Billie Mills, Jr. (J), James Cheng-Moa You (J).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Outside of Section Territory: Robert G. Beavers (J), William J. Evers (A), Alonzo M. Harp (A), Edward W. Pye (M), Lawrence A. Smith (A), Major Leo Tamamian (A), John E. Tobin (A), Harry Milford Willis (A).

Foreign: Fernando deMello Abreu (F M), (Portugal), Lt. Percival Lesmore Hancock (F M), (Australia), Ludwig Heilbrunn (F M), (England).

Texas Section: Lt. Leonard Carl Halverson (J).

Southern Ohio Section: Capt. Alan Howard Blair (J), John Wright Hickenlooper (J).

Applications Received

continued from p. 53

Northwest Section: Harry L. Freeman, Milton E. Gaetz, Asa T. Jones, Carl August Martens.

Oregon Section: Theodore Emerson Bokemeier, Louis Courtemanche, Jr., Jacob Henry Meyer, Edward C. Nelson, F. C. Purkeypile.

Philadelphia Section: George C. Abbe, William E. Cobey, Jr., Lars E. Ekholm, Oscar Epstein, Stanley M. A. Grabowski, Raymond B. Landis, Lawton B. Logan, Ensign John Edgar Mann, Charles Cochran Miller, Jr., Frank E. Miller, Hugh J. Mulvey, Richard Hickman Prewitt, John R. Winkle, Jr., Lester Wolfson.

Pittsburgh Section: Arthur Wayne Aspin.

St. Louis Section: Harold A. Carlson, Warren H. Cowdery, Olin Eickmann, Jr., Harris L. Hendricks, Everett David Philbrick, Jr., Paul J. Reese, A. D. Stauffer.

Southern California Section: Harold Victor Bordeaux, Fred D. Bowlus, Lawrence David Brandstedt, Clifton J. Brooks, Warren G. Furrey, Jr., John Jauregui, Henry Mezori, Hubert Estes Mishler, H. Albert Mitchell, Hubert R. O'Neil, Jr., Justin E. Pequegnat, Sr., B. G. Reed, William H. Shallenberger, Capt. Donald A. Stewart, Walter S. Taylor, Dr. Arthie M. Turrell.

Southern New England Section: Avery L. Bond, William P. Cross, Carl Holmstrom, Norman F. Jones, Bernard Freshney Shattuck, James E. Wheeler.

Southern Ohio Section: John F. Beeler, M. George Brown, Howard William Cole, Jr., William D. Hazlett, Sidney M. Kaufman, Ray Melin Kolb, Louis Lindenbaum, Charles E. Pruden, Kenneth D. Reed.

Syracuse Section: Harold E. Perry.

Texas Section: Waldo C. Cole, John W. Hendryx, John W. Horner, Francis B. Johnson, Maurice S. Williams.

Washington Section: H. M. Conway, David K. Morrison, C. Robley Patterson, Charles Sho-Had Tsiang.

Wichita Section: William Alvin Day, Horrell Gus Erickson, George L. Quinn, Harry Lawrence Reiter, E. W. Schroeder.

Outside of Section Territory: Major Servais Louis Evrard, M. W. Huber, Oliver H. Lovelace, Arnold E. Mareneck, Motor Coach Industries Ltd., Al G. Taylor.

Foreign: Donald Corbett-Smith, England. Walter Sydney Dack, England. William Ernest Dickinson, Australia. Manfred Gottermann, Palestine. Harold William Hogben, England. Kurt Bernhard Hopfinger, England. Norman Kendall, England. John James Andrew O'Hara, England. Arthur Wragg, England.

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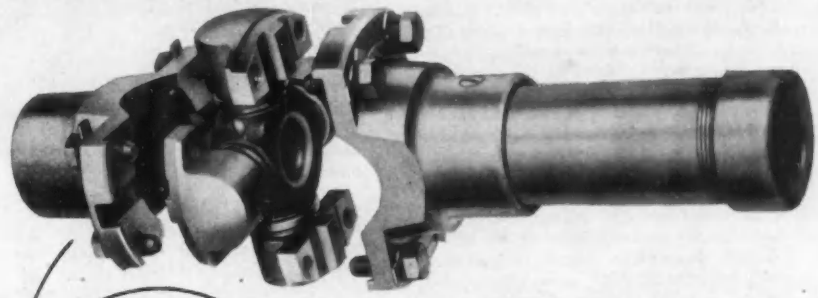

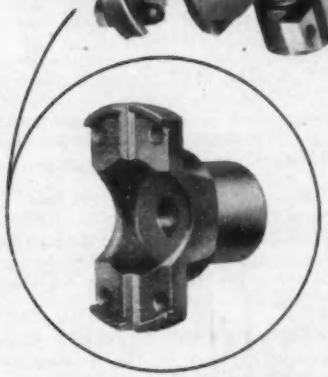

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ABOUT SAE MEMBERS

continued from p. 43

NEY, Aircraft Engine Research Laboratory, National Advisory Committee for Aeronautics, Cleveland, from principal mechanical engineer to assistant executive engineer; **WILLIAM H. VANN,** Pontiac Motor Division, General Motors Corp., Pontiac, Mich., from assistant plant manager to chief inspector; **RICHARD G. HORSCROFT,** Schwitzer-Cummins Co., Indianapolis, from test engineer in charge of experimental laboratories to project engineer in the Automotive Division; **HOWARD J. RICHARDS,** Freightliner Corp., Salt Lake City, Utah, from design and production engineer to engineer and purchasing agent; **WILLIAM HUDSON RAGSDALE,** AC Spark Plug Division, General Motors Corp., Flint, Mich., from war products field engineer to factory service representative on automatic pilot; **THEODORE P. WRIGHT,** Aircraft Production Division, War Production Board, Washington, from deputy director to director of aircraft resources control office; **HOWARD E. GRAHAM,** Illinois Central System, Chicago, from assistant supervisor, water service and work equipment to water service inspector; **GILBERT HOLM SWART,** General Tire & Rubber Co., Akron, Ohio, from research chemist to research director; **MICHAEL E. GLUHAREFF,** Sikorsky Aircraft Division of United Aircraft Corp., East Hartford, Conn.. formerly in charge of design and aerodynamics, now chief engineer; **LT.-COL. JOHN A. BARCLAY,** Tank-Automotive Center, Detroit, from chief of Parts and Supplies Section to executive assistant of Stock Control Branch; **E. P. LOTT,** United Air Lines, Chicago, formerly in charge of military operations, now director of design, buildings and airports; **C. M. DOERING,** Thompson Products, Inc., Cleveland, from assistant to plant manager; **A. R. WEIGEL,** Consolidated Steel Corp., Ltd., Los Angeles, from consulting engineer and production manager of the Naval Ordnance Division to chief engineer of research and development; **CHARLES HENRY RICHART,** Douglas Aircraft Co., Inc., from shop contact at the El Segundo plant to fuselage engineer at the Tulsa, Okla., branch; **JOSEPH PALSULICH,** Wright Aeronautical Corp., Paterson, N. J., from assistant to project engineer; **R. A. JEHEBER,** Mack Mfg. Corp., from assistant chief engineer in New York City to director of research at the Plainfield, N. J. plant; **W. F. AUG,** Mack Mfg. Corp., from manager of research at Allentown, Pa., to assistant research director at Plainfield, N. J.; **JOSEPH H. JONES,** Republic Steel Corp., from the metallurgical department in the Alloy Division, Massillon, Ohio, to superintendent in charge of Gun Bloom Works at Canton, Ohio; **CHARLES H. MILLER,** White Motor Co., from director of ordnance training in Cleveland to service manager at the Philadelphia plant; **B. H. GILPIN,** Chandler-Evans Corp., South Meriden, Conn., from executive vice-president to vice-president and general manager.

Among members of the Armed Forces who have received recent promotions are: **ARTHUR B. DOMONOSKE,** and **JOSEPH A. MOLLER,** Third Bomber Command, MacDill Field, Tampa, Fla., to colonel; **M. F. WEILL,** Headquarters Western Defense Command & Fourth Army, Office of Assistant Chief of Staff, San Francisco, and **FRANK A. QUACKENBUSH** to lieutenant colonel. Promoted to major were **MAURICE DE KAY THOMPSON KENNEDY,** Tank-Automotive Center, Detroit; **ALLEN TAYLOR,** Ordnance Service Command Shop, Richmond, Va.; **ROBERT CHARLES HALL,** Quartermaster Corps, Aberdeen Proving Ground, Md.; **KENNETH L. STEHLE,** A.P.O. 914, c/o Postmaster, San Francisco; **T. E. FRANKENFIELD,** Headquarters Squadron, Air Service Command, Patterson Field, Dayton, Ohio and **JOSEPH A. DOYLE,** Ordnance Department, A.P.O. 9061, c/o Postmaster, New York City. Among those commissioned as captains were **EDWARD T. LEUTWYLER,** Office of the Quartermaster, Camp Hood, Tex.; **RALPH T. HORGAN,** Motor Transport Battalion, c/o Fleet Post Office, San Francisco and **NATHAN R. ROSENGARTEN,** Flight Test Branch, Flight Station, Wright Field, Dayton, Ohio. **ROYCE CHILDS** is now a first lieutenant, while **RICHARD O. McMANUS, EDWIN A. HARDY,** USMC, and **EDWARD A. SUTHERLAND** have been raised to second lieutenant. **WILBUR R. VESTER** is an aviation cadet stationed at Amarillo, Tex., and **JOHN J. O'DONNELL,** 560th Ordnance, Heavy Maintenance Company (TK), Fort Lewis, Wash., is now a staff sergeant.

The Navy promoted **CLARENCE H. SCHILDHAUER,** Naval Air Transport Service, Navy Department, Washington, to captain; **W. L. ANDERSON,** Industrial Department, Navy Yard, Mare Island, Calif., to commander; **LELAND S. PRIOR, JR.,** Naval Air Station, Moffett Field, Calif. and **C. N. PAXTON,** Bureau of Aeronautics, Washington, to lieutenant commander; **EARL W. SHAW, JR.,** Lockheed Aircraft Corp., Burbank, Calif., to lieutenant, and **RALPH E. CARLSON,** Underwater Defense Department, Navy No. 135, F.P.O. San Francisco and **KENNETH E. MONTAGUE,** Inspector of Naval Aircraft, Douglas Aircraft Co., Inc., El Segundo, Calif., to lieutenant (jg).

FRANK M. AULD is now a second lieutenant in the Royal Canadian Ordnance Corps, Canadian Army. He had been tool designer for Regina Industries, Ltd., Regina, Saskatchewan, Canada.

N. K. G. THOLAND, president of Ekstrand & Tholand, New York City, is chief consultant, industrial engineering division, Office of Economic Warfare.

ROY A. GARNETT, formerly connected with Sherbrooke Machineries, Ltd., Toronto, Ontario, Canada, as chemical and mechanical engineer, is now assistant manager for Whiting Corp. (Canada) Ltd., same city.

Previously an instructor for the Board of Education, City of Los Angeles, **JOSEPH W. CORLEY** has entered the U. S. Army Air Forces as a first lieutenant. He may be reached at the Roswell Army Air Field, Roswell, N. M.

EVERT C. HOKANSON, formerly senior maintenance engineer for the Aviation Division, Whiting Corp., Harvey, Ill., is now a lieutenant in the U. S. Navy, stationed at the U. S. Naval Air Station, Patuxent River, Md., where he is staff engineering officer for the Atlantic Wing, Air Transport Squadron.

ALAN JOHN BYLL, formerly design calculator for Atlas Imperial Diesel Engine Co., Oakland, Calif., is now a consult on vibration for Joshua Hendy Iron Wor Sunnyvale, Calif.

JOSEPH A. WISELY has resigned fr the engineering department of the H peller Division, Curtiss-Wright Corp., Ca well, N. J., where he was design engin of the Project Group, to enlist in the U. Navy as an aviation cadet.

HARRY M. WILLIS, who had been a craft inspector for Lockheed Overseas Cor Burbank, Calif., is now with Wright Aer nautical Corp., Paterson, N. J., as field s vice representative.

JOHN W. GREER is now in the U. Army, Transportation Service, stationed the New Orleans Port of Embarkatio Marine Crewing Office. He had previous been engine designer for Electro-Mot Division, General Motors Corp., La Grang Ill.

JOHN W. WHITE is no longer wi Bendix Aviation, Ltd., North Hollywood Calif., as director of engineering of the Hy draulics Division. He is now chief engine of Technical Oil Tool Corp., Ltd., sam city.

AGE SKIOLVIG, a lieutenant commande in the U. S. Navy, may be reached at 10 Navy 121, Fleet Post Office, San Francisc Commander Skiolvig was formerly manage of products manufacturing department, She Oil Co., Inc., New York City.

IVOR H. WILLIAMS, who had bee project engineer for Timken Detroit Axle Co., Detroit, is now connected with the Ohio Tool Co., Cleveland.

ROBERT R. ALLEN has joined Carl L. Norden, Inc., New York City, as senior engineer. He had formerly been supervising engineer and general foreman of Lucas-Harold Corp., Indianapolis.

JOSEPH C. FIREY has entered the U. S. Navy as an ensign, and is stationed at Fleet Torpedo School, U. S. Naval Repair Base, San Diego, Calif. As a civilian, he had been assistant research engineer of Standard Oil Co. of Calif., Richmond, Calif.

Previously fuel injection serviceman for Automotive Products, Inc., Portland, Ore. **CLARENCE F. OSTERMAN** is now diesel fuel injection serviceman of Ohler Diesel & Electric Co., Spokane, Wash.

FRED W. ZELLMER, formerly foreman of flight and service at Consolidated Vultee Aircraft Corp., San Diego, Calif., is now a first lieutenant in the U. S. Army Air Forces, and may be reached at Headquarters, Air Transport Command, Washington.

ORREN E. ZODER, who had been general manager of operations, Anderson Motor Service Co., St. Louis, Mo., is now president of Zoder Transport, Inc., same city.

PAUL O'CONNOR LOWEN, formerly field engineer at Continental Motors Corp., Detroit, is now with Chandler-Evans Corp., South Meriden, Conn., as field engineer.

MAJOR L. S. REVES has been transferred from Camp Callan, San Diego, Calif., where he was post automotive officer for the past two years, to Fort Lewis, Wash., where he has been assigned as deputy director for

bined Maintenance Shops, Supply & ice Division.

P. GEDDES, JR., is no longer pur ing agent for American Amplifier & phone Co., Los Angeles, having joined lix Aviation, Ltd., North Hollywood, f., as contract administrator for hy- lic and radio divisions.

OHN J. FRANZMAN is now manager the Lubricants Division of Babbitt In- rial Specialties Co., New York City. was formerly associated with Cities ice Oil Co., same city, as manager of ional account sales.

Formerly connected with the engineering artment of Fram Corp., East Providence, I., **ROBERT L. HARTLEY** is now field ineer for Chandler-Evans Corp., South rden, Conn.

AYMOND LOEWY, industrial designer New York City, has been assigned to ign Emerson radios of the future, serv- Emerson exclusively in the radio field.

P. S. PARKER has joined Airzone 931) Ltd., Camperdown, N.S.W., Aus- lia, as general manager. He was for- erly director and general manager of sen (Aust.) Pty., Ltd., subsidiary of In- national Radio Co., Sydney, Australia.

COL. T. L. PREBLE, has been trans- red from the Second Army Command, shville, Tenn., to the Post Ordnance ffice, Fort Knox, Ky.

T. A. O'CONNOR, formerly district sales nager and recently war production rep- entative for the Studebaker Pacific Corp. Los Angeles, has been appointed assistant the vice-president of the company.

JOHN SUNDSBAK, who had been a ster and mechanic, for the War Produc- ent, Chicago Signal Depot, Clearing Sta- n, has retired, and is now living on his rm in Leesburg, Fla.

Previously assistant chief of maintenance, British West Indian Airways, Port of Spain, Trinidad, B. W. I., **GEORGE S. LACE** has en named assistant superintendent of aintenance of Transportes Aereos Cen- os Americanos, San Jose, Costa Rica.

DE OWEN NICHOLS, JR., a captain in e U. S. Army Air Forces, is engineering ficer at Power Plant Laboratory, Wright ield, Dayton, Ohio. Captain Nichols had en stationed at the Tank-Automotive Cen- r, Detroit.

MARTIN JOHN NEUMEYER, formerly nior mechanical engineer for General otors Corp., Research Laboratories Divi- n, Detroit, is now a mechanical engineer r General Motors Overseas Operations, ew York City.

CHARLES EDMONDS, formerly salvage gineer at Beech Aircraft, Wichita, Kan., as resigned to enroll in Colorado College, olorado Springs, as a student.

HARRY AGERTER, who had been vice- esident and general manager of Aircraft Components, Inc., Van Nuys, Calif., is now les manager of the Aircraft Division, En- neering & Research Corp., Riverdale, Md.

CHARLES H. KANAVEL, connected ith B. F. Goodrich Co.'s Automotive Avia- on and Government Sales Division, Akron, hio, has been named manager of the com- any's Track and War Products Depart- ent.

EDWARD P. RILEY was promoted from hief chemist of Thompson Products, Inc., Cleveland, to sales engineer of the Aircraft Accessory Division of the company.

C. L. BROSSEAU, formerly district manager of Mack-International Motor Truck Corp., Albany, N. Y., has joined the subcontract department of the Allentown (Pa.) branch of the company.

O. H. BANKER has been advanced from vice-president in charge of engineering to president of New Products Corp., Chicago.

JOHN L. COLLYER, president of B. F. Goodrich Co., Akron, Ohio, discussed America's rubber position after the war in the Town Hall Meeting of the Air, Dec. 16.

Members of the SAE from the Weatherhead Co., Cleveland, who attended the recent SAE-NASC-Aircraft-Industry Hydraulics Meeting in Chicago were **HEYLIGER CHURCH,** manager of the Airplane Division; **L. J. HENDERSON,** assistant manager of the Aviation Division; **H. A. ZIMMERMAN,** engineering department; **GEORGE H. HUFFERD,** director of research, and **J. E. SZITAR,** products engineers. Reports were made by various representatives of the Armed Forces and the aircraft industry regarding special problems encountered in the maintenance and servicing of aircraft hydraulic systems in different theaters of war.

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J. C. HOIBY, chief engineer, D. W. Onan & Sons, spoke before the Minneapolis Engineers Club at a luncheon meeting Dec. 10. The topic of his talk was "Combat Electrification."

L. F. ADAMS, assistant vice-president and manager of the Standards Division, General Electric Co., Schenectady, N. Y., was appointed head of the Standards Policy Committee which will be responsible for development and maintenance of design engineering and manufacturing standards and practices for use throughout the company.

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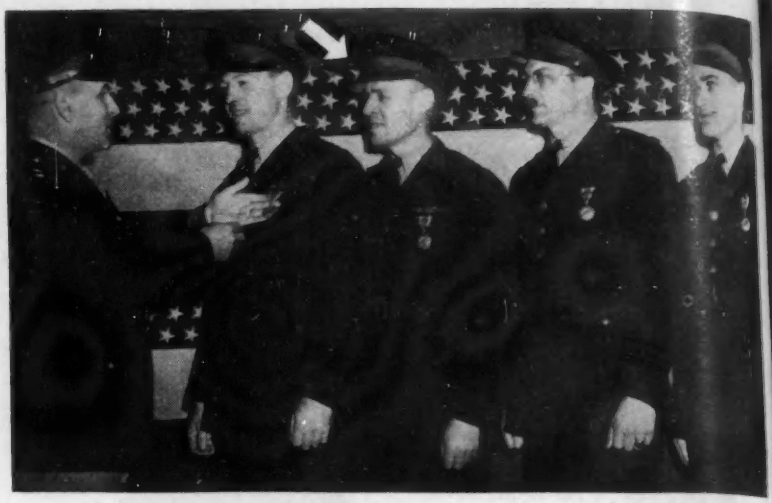

M. Gould Beard, third from the left (arrow) who, with members of a survey crew which blazed the air trail in an American Airlines transport plane from Newfoundland to North Africa, received the War Department Air Medal from Major-Gen. Harold L. George (left), commanding general of the AAF Air Transport Command. Seldom awarded to civilians, the citation read in part: "for outstanding professional ability in the performance of duty" over an untried route in a nonstop 11 hr flight. Mr. Beard, for 15 years an SAE member, read papers before the SAE National Aircraft Production Meeting, Oct. 15-17, 1936; SAE National Aeronautical Meeting, March 16 and 17, 1939, and again at the 1942 meeting, March 12 and 13

OBITUARIES

Joseph A. Anglada

Joseph A. Anglada, for more than 35 years a member of the Society, a vice-president in 1915 and a member of the Council for two terms, died Dec. 14 in Abington, Pa.

Having been a member of the Metropolitan Section Governing Board for several years, he was elected chairman for the 1914-15 term.

At the time of his death he was senior automotive engineer of the Philadelphia Ordnance District, having served as a consultant to the Ordnance Department in Washington before and after Pearl Harbor. For many years a consulting automotive engineer who developed numerous inventions, Mr. Anglada was chiefly known in the field of engine development. His first work, at the turn of the century, was with the International Power Co., Providence, where he developed one of the earliest electrical vehicles. He soon switched to the internal combustion engine, and became vice-president of the Commercial Car Unit Co., Philadelphia From 1928 to 1936 he was president of the Anglada Motor Corp., New York, and continued his work up until he was called into service by the Army a few years ago as a consulting engineer.

From 1911 until his death he had served on numerous SAE administrative and technical committees, and was chairman of the Coker F. Clarkson Memorial Committee in 1939. Born in New York City on Jan. 29, 1880, he was a graduate of Pratt Institute and completed his work for a graduate degree in mechanical engineering in Columbia University. In 1905 he was an electrical engineer with the Amalgamated Gold Mines Co., Quartsite, Ariz.

Frank A. Ross

Frank A. Ross, senior vice-president of Stewart-Warner Corp., died suddenly on Nov. 17. He was 60 years old. Largely responsible for the successful and widespread use of the vacuum tank on automobiles, and a pioneer in the automotive and allied accessories field, Mr. Ross was, in point of service, the oldest executive with Stewart-Warner. He joined the organization as an engineer in 1908 when it was the Warner Instrument Co., and later, with the formation of the Stewart-Warner Speedometer Corp., became assistant superintendent and superintendent and works manager.

Samuel M. Havens

Samuel M. Havens, vice-president of Wyman-Gordon Co., manufacturers of drop forgings, died Nov. 4 at the age of 66. A graduate from the University of Rochester and Columbia Law School, Mr. Havens practiced law until 1917, when he entered the Ingalls Shepard Division of Wyman-Gordon Co. He had been a member of the SAE since 1920, as well as secretary of the Board of Trustees of his alma mater and president of the Central Alumni Association of that university.

Glen Grover Holt

Glen Grover Holt, vice-president of the Perfex Corp. and an authority on radiator design, died at the age of 47 on Nov. 26. A native of Salt Lake City, he attended the University of Utah and Utah Agricultural College. He was an associate member of the SAE since 1937.

There's <u>still</u> a big job for all of us to do

NOTHING MATTERS NOW except the swift and certain winning of the war.

Through the prodigious production accomplishments of American industry, our men and our Allies have been able to swing the initiative in fighting to our side.

To keep it...to continue a steady march on the bloody road to victory... we've got to give our men in the thick of the fight everything they'll need. And give it to them faster and faster!

For you and for us there's *still* a big job to be done. The history of the amazing production performance of American industry is *still* to be written.

Every single man-hour, every bit of brain power, every ounce of industrial energy expended for any purpose other than victory will damage the war effort.

The entire production of Hyatt Roller Bearings now goes into planes our men fly... into tanks they drive... into ships they sail... into guns they man... into equipment they need to win.

In the midst of pouring out a tremendous stream of bearings for this vital war use, we pause to again thank industry for its grand cooperation and understanding, and for helping us meet war's demands for super-precision production on a mass scale.

As soon as the war's won, and this job is done, Industry and Hyatt will have another big job to do together... when we can work in Peace.

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

DIVISION OF

HYATT BEARINGS **GENERAL MOTORS**

SAE student members newly engaged in engineering work at various production plants throughout the country include:

	Formerly at	Employed by
EDWARD D. HEINS	Chrysler Institute of Engineering	Chrysler Corp.
ROBERT E. BULFORD	Aero Industries Technical Institute	Northrop Aircraft, Inc.
UMBERT G. BALDASSARRI	New York University	Grumman Aircraft Engineering Corp.
JACK W. BARRETT	College of the City of New York	ISC Flame Cutter Corp.
JULIUS RAFALOW	College of the City of New York	Emerson Radio Co.
SYDNEY L. TERRY	Chrysler Institute of Engineering	Chrysler Corp.
ROBERT E. KLUBER	Iowa State College	Curtiss-Wright Corp.
JOHN REESE ESTERLY	Ohio State University	National Advisory Committee for Aeronautics
LAWRENCE I. GUNDERSON	University of Calif. at Los Angeles	Kroehler Mfg. Co.
EDWARD FRANK EGER	Illinois Institute of Technology	Beck-Lee Corp.
HOWARD D. GOLDGRABER	Cooper Union School of Engineering	General Electric Co.
ALBERT KRINSKY	College of the City of New York	Eclipse Aviation Division
JOHN H. JOBOUL	Illinois Institute of Technology	RCA Victor Division
LEON ELDON GREELEY	Iowa State College	Chevrolet Motor Division
RICHARD F. ENGLERT	Aero Industries Technical Institute	Lockheed Aircraft Corp.
WILLIAM W. DRONBERGER	Aero Industries Technical Institute	United Air Lines Corp.
ARTHUR J. BETTINGER	Cooper Union School of Engineering	Arma Corp.
WALTER J. KINGSCOTT, JR.	Chrysler Institute of Engineering	Chrysler Corp.
WALDEMAR C. LINDSTROM	Purdue University	Allison Division
KENNETH W. SCHMIDT	University of Wisconsin	North American Aviation, Inc.
IRVIN S. TARRSON	Illinois Institute of Technology	Fairchild Aircraft Corp.
JAMES T. COLIZ	University of Wisconsin	Curtiss-Wright Corp.
BRUNO E. STECHBART, JR.	Illinois Institute of Technology	W. F. Hebard & Co.
ROBERT VAN DORAN	Rutgers University	Pioneer Engineering & Mfg. Co.
DONALD WM. GARNETT	Michigan State College	Pratt & Whitney Aircraft
CHARLES A. ARMITAGE	General Motors Institute	Oldsmobile Division
LEWIS CHARLES PASCOE	General Motors Institute	Chevrolet Motor Division
JOHN J. STERRETT	General Motors Institute	Allison Division
ROBERT K. STONE	Chrysler Institute of Engineering	Chrysler Corp.
JOHN D. STANITZ	Massachusetts Institute of Technology	National Advisory Committee for Aeronautics
ARNOLD SCHINDEL	Cooper Union School of Engineering	Bendix Aviation Corp.
ALEX PETROVSKY	New York University	Grumman Aircraft Engineering Corp.
JOHN B. MEIGS	University of Wisconsin	National Advisory Committee for Aeronautics
EVERETT A. POORE	Tufts College	Wright Aeronautical Corp.
SAMUEL J. RAFF	College of the City of New York	General Electric Co.
GORDON T. SAWYER	Chrysler Institute of Engineering	Chrysler Corp.
MAX J. TAUSCHEK	University of Wisconsin	National Advisory Committee for Aeronautics
DAVID W. RENDALL	University of Wisconsin	Allis-Chalmers Mfg. Co.
ROBERT H. ESSIG	Purdue University	National Advisory Committee for Aeronautics
WILLIAM V. HANZALEK	Cooper Union School of Engineering	Wright Aeronautical Corp.
IRVING P. POLAK	Pennsylvania State College	Philadelphia Navy Yard
EDWARD G. VOLICK	Detroit Institute of Technology	Chrysler Corp. of Canada, Ltd.
T. W. HUURTO	Lawrence Institute of Technology	Chrysler Corp.
HARLAN HOUGHTBY	Lawrence Institute of Technology	Vickers, Inc.
JOHN M. ALLEN	Haverford College	National Advisory Committee for Aeronautics
DAVID E. ERICKSON	Iowa State College	Goodyear Tire & Rubber Co.
HERBERT H. WEISS	Illinois Institute of Technology	The Buda Co.
KENNETH S. KENNEDY	Lawrence Institute of Technology	Eaton Mfg. Co.
STANLEY LEHRER	College of the City of New York	Eastern Aircraft Division
MYRIN I. LUNDIN	College of the City of New York	General Electric Co.
ERNEST WM. HEDEEN, JR.	Illinois Institute of Technology	Mall Tool Co.
DALE O. SMITH	General Motors Institute	Allison Division
JOHN P. NORDHAUS	Illinois Institute of Technology	RCA Victor Division
EARL A. SERRY, JR.	Aero Industries Technical Institute	National Advisory Committee for Aeronautics
VERNON R. VORWERK	University of Wisconsin	North American Aviation, Inc.

Aero Engine Fan Committee Formed

continued from p. 50

Committee, of which H. E. Morton, Sturtevant Fan Co., is chairman, are:

P. A. Sidell, DeBothezat Division, American Machine & Metals Co.; Leslie T. Miller, representing the National Aircraft Standards Committee, and powerplant engineer of Glenn L. Martin Co.; T. H. Carson, Aeroproducts Division, General Motors Corp.; George A. Dean, Curtiss Propeller Division; R. P. Lambeck, Hamilton Standard Propellers; H. G. Braendel, Continental Motors Corp.; Gustaf Carvelli, Wright Aeronautical Corp.; Chester C. DePew, Ranger Aircraft Engines; A. Hasbrouck, Pratt & Whitney Aircraft; C. J. McDowell, Allison Division, General Motors Corp.; A. W. Rickenbach, Lycoming Division, The Aviation Corp.; W. P. Robinson, Jacobs Aircraft Engine Co. and Gordon Seavey, Aircooled Motors Corp.

Reports on Conservation Of Rubber for Ordnance

PROGRESS Report No. 10 of the SAE-War Engineering Board's Rubber committee, under the chairmanship of W. J. McCourtney, Chrysler Corp., on Rubber Substitutions in Artillery Carriages and Guns, has been forwarded to the Army Ordnance Department.

The committee studied blueprints and specifications of the weapons and their accessories and made the report for use by the Technical Division, Ordnance Department, at the request of Lt.-Col. J. H. Frye.

Serving on Mr. McCourtney's committee were 14 engineers of truck, automobile, rubber, and accessory manufacturing companies.

Great importance has been attached by Major-Gen. Levin H. Campbell, Chief of Ordnance, and Major-Gen. G. M. Barnes, Chief, Technical Division, to this series of rubber conservation reports. Many involved intensive laboratory and field tests, much of which was done in companies represented.

New Cowl Flap Control Committee Has Been Formed

THE problem of standardizing bulb sizes and envelopes for the cylinder head temperature pick-up operating mechanism has been assigned by the SAE Aircraft Engine Subdivision to a new committee headed by Wayne Cannon, Wright Aeronautical Corp.

The committee, E-14-A, Automatic Cowl Flap Controls, prepared a tentative draft for discussion Dec. 21 in New York where military representatives and accessory manufacturers discussed details of the problem.

Serving on the committee are Thomas Ball, Jr., Revere Co.; Kenneth A. Browne, Wright Aeronautical Corp.; H. R. Crago, General Electric Co., and D. S. Hersey, Pratt & Whitney Aircraft.

Electronics Specialists

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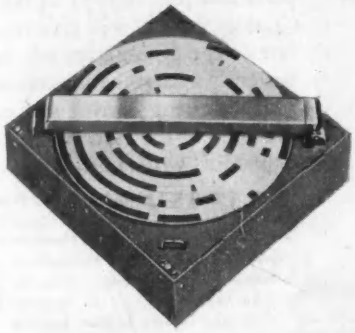

AUTOMATIC PROCESS CONTROL

This new development by the research laboratories of General Electronics Industries provides automatic control of chemical processes and also of production machinery, by means of printed charts which may be replaced or interchanged as readily as phonograph records.

● Jacks-of-all-trades have their place . . . but *not* in General Electronics Industries. Everyone in this organization, from top-flight research engineers to service men and their assistants, is an electronics specialist.

We have no miracle gadgets nor mysterious cure-alls for sale. Our business is the proper application of electronics to solve individual production problems. This begins with diagnosis, *follows through* with research, perhaps special design, and includes expert service before and after completion of the job.

To assist you in your post-war production planning, one of the largest organizations specializing in electronics offers the skill, experience and unsurpassed facilities that have successfully met the most exacting tests of war.

Write to Engineering Department, General Electronics Industries, 342 West Putnam Avenue, Greenwich, Connecticut.

Other products manufactured include: **ELECTRONIC CONTROLS • VACUUM TUBES • HYDRAULIC SERVOS COMMERCIAL RADIO EQUIPMENT • ELECTROMECHANICAL DEVICES • ELECTROSTATIC HEATING UNITS UP TO 250 KW.**

ARMY-NAVY "E" WITH STAR awarded to Auto-Ordnance Corporation for continued excellence in production of "Tommy" Guns.

GENERAL Electronics INDUSTRIES

Division of Auto-Ordnance Corporation

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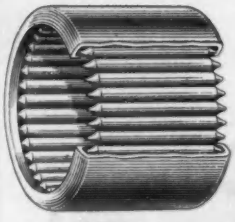
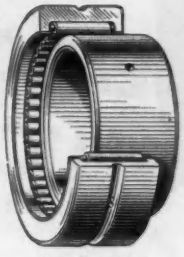
CONTRIBUTE TO INFANTILE PARALYSIS FUND—JANUARY 16TH TO 31ST

Yes, these are ALL Needle Bearings . . .



TYPE DC



TYPE NCS

DESIGNED FOR TODAY'S NEEDS AND TOMORROW'S TRENDS—THEY OFFER A UNIQUE COMBINATION OF ADVANTAGES

You may not have realized how many *different* types of Needle Bearings have been developed since the first Torrington Needle Bearing was introduced.

Some of them are illustrated here.

Common Advantages

All of them employ the basic principle of a full complement of small diameter needle rollers within a single, compact retaining raceway. And all of them offer the characteristic advantages of the original Torrington Needle Bearing:

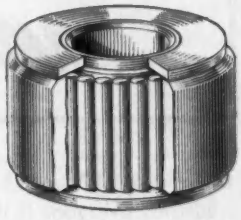
1. Small size, light weight and compact design
2. High radial load capacity and elimination of stress concentration
3. Unit construction which facilitates handling and installation
4. Efficient lubrication; freedom from maintenance attention
5. Low cost

For Special Requirements

Each of the "newer" types is designed for a particular task . . . a particular set of conditions.

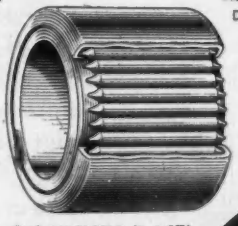
Some of them were so well established even before the war as to be almost universally used for certain applications. For example, the NCS Type Needle Bearing, of rugged construction, designed for heavy service, and available in standard sizes to fit an inner race of from ⅝" O.D. to 5½" O.D., is widely employed in equipment for the oil industry where service conditions are severe and rough "handling" the rule.

Others are the result of wartime demands for greater efficiency in speeding production lines and stepping up performance records. The AT Type Needle Bearing, for instance, has a heavy, through hardened outer race designed to give maximum capacity obtainable from the rollers



TYPE AT

used. It has found wide application in the aircraft construction where it is used with standard AN bolts and is designed to have a static non-Brinell capacity equal to the single shear strength of the bolt. Standard sizes in the AT Type range from 0.1900 to 1.0000" to fit on bolts No. 3 to 16.



DC (INNER RACE)

For Postwar Designs

Where the efficiency of anti-friction operation is desired, and space, weight and cost are vitally important considerations—as they will be in d signing to meet postwar trends Needle Bearings provide the answe

With the development of a co plete line of all types, The Torringto Company offers the product design and engineer a selection to meet vi tually *any radial load requirement.* Th experience of Torrington engineer is available to aid in design and ap plication of Needle Bearings to *you* particular job. A copy of our curren Catalog No. 122 will give you an out line of the types, sizes and capacitie currently available for essential needs And if our engineering staff can assist in selecting the right type for a par ticular job, write, outlining your need.

THE TORRINGTON COMPANY

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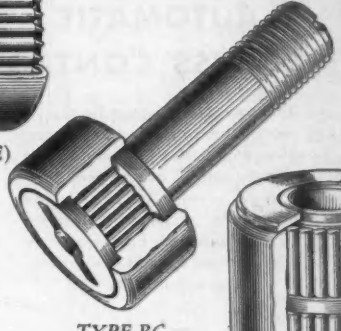

TYPE RC

TYPE FDT

TORRINGTON
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